Series 50 T (M1310A) Fetal Telemetry System

SERVICE GUIDE

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- the instrument is used in accordance with the *Instructions for Use* or *User's Guide*.

Important

United States federal law restricts this device to sale by or on the order of a physician.

This device is not intended for home use.

Warning
Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.

Printing History

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About this Manual

The manual is intended for personnel involved in the service and repair of the M1310 Telemetry System.It enables you to diagnose and repair problems with the minimum of inconvenience to the customer.

The philosophy for on-site diagnosis and repair of the M1310A Telemetry System can be summarized as follows:

- General Repair Strategy
    - On-site repair for standard assemblies.
    - Bench repair for RF-repair.

The recommended repair method is replacement of assemblies.

Every 12 months, you must carry out a series of preventive maintenance tasks and performance assurance tests. Details can be found in Chapter 10, “Preventive Maintenance, Care and Cleaning”.

For an overview of the system, and how to set it up, please refer to the *Instructions for Use*.

Conventional current technical terms are used throughout the manual, and familiarity with these terms is assumed.

The following conventions for cautions and warnings are used in this guide:

***Note*— A note calls attention to an important point in the text.**

Warning
A warning calls attention to a condition or possible situation that could cause injury to the user and/or patient.

Caution
A caution calls attention to a condition or possible situation that could damage or destroy the product or the user’s work.

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Contents

1.Safety 1
Safety Symbols 1
Patient Safety 2
Environment 2
Protective Earth 3
Maximum Input/Output Voltages 4

2.Technical Specifications 5
Telemetry System (Receiver and Transmitter) 5
Power Requirements 5
Environment 5
Dimensions and Weight 5
Controls and Indicators 6
Channels and Frequencies 6
Antenna 6
Inputs 6
Outputs 7
Input Sensitivity 7
Output Power 7
Image Rejection 7
Self-Test Facilities 7
Transducers and Cables 8
External Blue Toco Transducers (M1355A) or (M1355A Opt. C03) 8
Blue Ultrasound Transducer (M1356A) or (M1356 Opt. C03) 8
DECG Transducer (M1357A) 9
DECG/MECG Patient Module (M1364A) 9
IUP Quartz Transducer (1290C #J05) 9
IUP Pressure Transducer (CPJ840J5) 10
Remote Event Marker (15249A) 10

3.Tests and Error Messages 11
Testing the Receiver 11
Testing the Transmitter 12
Testing the Parameter Signals 13
Error Messages 14
Series 50 Family 14
8040A 14
8041A 15

4.Troubleshooting 17
Solving General Problems 17
No LEDs Lit on Receiver (continued overleaf) 19
Not all Receiver LEDs are Lit 21
Yellow LED Remains Lit 21
Transmission INOP Range 22

Transmission Range 23
Transducer Mode Not Detected 24
Cardio Channel 25
TOCO Channel 26
FMP 27
FMP Test 27
Event Marker 29
Nurse Call 30

5.Interfacing to a Fetal Monitor 31

6.Using the Service Software 33
Prerequisites 33
Running the Service Software Program 34
Using the Service Program 35
Main Menu 35

7.Replacing Parts 39
Ordering Parts 39
Service Tools 40
Lists of Parts 40
Transmitter 40
Receiver 42
Dismantling the Transmitter 46
Transmitter Processor Board 47
Transmitter VCXO 50
Dismantling the Receiver 51
Power Supply Board 53
Processor Board 54
RF Module 55
Receiver VCXO 56
RF Amplifier 57
Display Board 57
Fuses 58

8.RF Bench Repair 59
Introduction 59
What You Need 59
Transmitter VCXO Test 60
Receiver Preamplifier Test 64
Receiver Assembly Test 65
Receiver VCXO Test 66

9.Theory of Operation 69

Transmitter Functional Blocks 69
US Gating 69
US Driver 69
US Receiver 69
ECG Driver 70
ECG Receiver 70
Dynamic Compression Circuitry 70
FMP Detector 70
Modes 71
Toco Driver 71
Toco Receiver 71
Toco A/D 71
FSK Generator 71
Oscillator 72
Power Supply 72
Service Interface 72
EEPROM 73
Japan ID 73
VCXO 73
Receiver Functional Blocks 74
Input Filter 74
RF Preamp M1406A 74
RF Receiver M1402A 75
US Bandpass 75
ECG Bandpass 75
FSK Bandpass 75
FSK Demodulator 75
Toco D/A Converter 76
EEPROM 76
Service Interface 76
Power Supply 76
Oscillator 76

10. Preventive Maintenance, Care and Cleaning 77

Preventive Maintenance 77
Mechanical Inspection 77
Safety Tests 77
Performance Assurance Tests 77
Care and Cleaning of the Telemetry System 78

11. Channels and Frequencies 79

VCXO Operation Frequency 79
Austria 79
Australia 79
Belgium 80
Canada 80
Denmark 81
Eastern European Countries 82
Finland 82

France 82
Germany 83
Italy 84
Japan 84
Luxembourg 85
Netherlands 85
New Zealand 86
Norway 86
Service USA 87
Singapore 87
Spain 87
Sweden 88
Switzerland 88
UK 89
USA 89

List of Figures

Figure 1 Troubleshooting: No LED's Lit on Receiver 19
Figure 1 Troubleshooting: No LED's Lit on Receiver (continued from previous page) 20
Figure 2 Troubleshooting Receiver LEDs 21
Figure 3 Troubleshooting: Yellow LED stays on 21
Figure 4 Troubleshooting: Transmission INOP 22
Figure 5 Troubleshooting: Transmission Range 23
Figure 6 Troubleshooting: Transducer not detected 24
Figure 7 Troubleshooting: Cardio Channel 25
Figure 8 Troubleshooting: TOCO Channel 26
Figure 9 Troubleshooting: FMP 27
Figure 10 FMP Test 29
Figure 11 Troubleshooting: Nurse Call 30
Figure 12 Cable assembly 33
Figure 13 Transmitter Parts 41
Figure 14 Receiver Boards 43
Figure 15 Receiver Parts 45
Figure 16 Transmitter VCXO Test 60
Figure 17 FSK Signal 61
Figure 18 RF Output Signal 2
Figure 19 RF Modulation Signal 63
Figure 20 Receiver Preamplifier Test 64
Figure 21 Receiver Assembly Test 66
Figure 22 Receiver VCXO Test 67

1
Safety

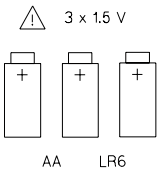
Safety Symbols

Read this information before setting up, using or servicing your Series 50 T Telemetry System.

FCC WARNING

This equipment generates, uses and radiates radio-frequency energy, and if it is not installed and used in accordance with this manual, may cause interference to radio communications.

Operation of this equipment in a residential area may cause interference, in which case the users, at their own expense, must take whatever measures may be required to correct the interference.

	This symbol indicates that you should consult the *Instructions For Use*, and particularly any warning messages.
	Equipotential Terminal This symbol identifies terminals which are connected together, bringing various equipment or parts of a system to the same potential. This is not necessarily earth potential. The value of potentials of earth may be indicated adjacent to the symbol.
	Protective Earth Terminal This symbol identifies the terminal for connection to an external protective earth system.
	**Battery 3 x 1.5V** This symbol identifies the transmitter battery holder. It takes three 1.5 V batteries (AA size, LR6 type).

Three types of battery can be used in the transmitter:

- Alkaline
- NiCd (rechargeable)
- NiMH (rechargeable).

Caution

Remove the batteries if you do not intend to use the Transmitter for a long period of time, to avoid damage from leakage.

Patient Safety

The Telemetry System should only be used by, or under the direct supervision of, a licensed physician or other health care parctitioner who is trained in the use of fetal heart rate monitors and in the interpretation of fetal heart rate traces. US federal law restricts this device to sale by, or on the order of, a physician.

The Telemetry Receiver is a Protection Class 1, Type B instrument. It is designed to fulfill safety requirements according to IEC 60601-1, UL 544 and CSA-C22.2 No.601.1-M90.

The telemetry transmitter is a battery operated device, applied parts (patient connectors) are Type CF .

Environment

Use the system in an environment which is reasonably free from vibration, dust, corrosive or explosive gases, extremes of temperature and humidity. It operates within specifications at ambient temperatures between 0 and +45°C. Ambient temperatures that exceed these limits can affect the accuracy of the system, the transmitter radio frequency transmission, and can damage the components and circuits.

The system (not including transducers[1]) can be stored at ambient temperatures between -40°C and +75°C.

The blue Toco and Ultrasound transducers are water-tight to a depth of 50 cm (19.7 inches).

Warning
Do not use brown transducers to monitor patients under water. Ultrasound and Toco transducers that are colored blue are watertight and comply with IEC 529 (IP68).

You can immerse the BLUE Ultrasound and Toco tranducers in water ONLY when connected to the telemetry transmitter. NEVER connect blue transducers directly to the fetal monitor when they are immersed in water, or likely to come in contact with water.

NEVER immerse the telemetry transmitter in water or other liquids such as cleaning solutions.

1. Transducers can be stored at temperatures between -40°C and +60°C (-40°F to +140°F).

Protective Earth

To protect hospital personnel and the patient, the cabinet must be grounded. Accordingly, the receiver is equipped with a 3-wire power cable which grounds it to the power line ground when plugged into an appropriate 3-wire receptacle. Do not use a 3-wire to 2-wire adapter with the receiver. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury.

Whenever it is likely that the protection has been impaired, the receiver must be made inoperative and be secured against any unintended operation.

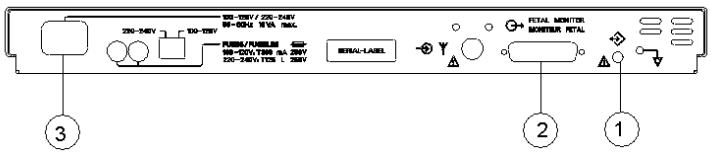
Warning
Check each time before use that the Telemetry System is in perfect working order and the receiver is properly grounded.

The patient cable must be positioned so that it does not come into contact with any other electrical equipment.

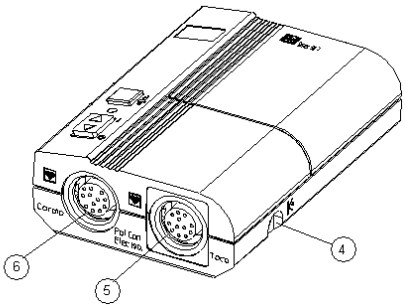
Before operation, make sure that the receiver is free from condensation. This can form when equipment is moved from one building to another, and is exposed to moisture and differences in temperature.

Warning
Possible explosion hazard if used in the presence of flammable anesthetics.

Maximum Input/Output Voltages



Receiver (Rear View)



Transmitter

1. Service Socket
   Maximum voltage of ±12V.
2. Socket to Fetal Monitor
   Maximum voltage of ±12V.
3. Power Input Socket
   100-120V ~ or 220-240V ~
4. Event Marker/Service Socket
   Maximum Voltage of +5V.
5. Toco Socket
   Maximum Voltage of +5V.
6. Cardio Socket
   Maximum Voltage of +5V.

2
Technical Specifications

Telemetry System (Receiver and Transmitter)

Power Requirements

The Telemetry System is set for the correct voltage at the factory, but before you connect power, ensure that the voltage switch is in the correct position for your country.

Operating Voltage:	100V - 120V~ or 220V - 240V (±10%).
Line Frequency:	50 to 60Hz.
Power Consumption:	19VA max.
Battery Type:	3 x 1.5V (AA size).

Environment

The Telemetry System should be used in an environment which is reasonably free from vibration, dust, corrosive or explosive gases, extremes of temperature and humidity. It operates within specifications at ambient temperatures between 0 and 45°C . Ambient temperatures which exceed these limits can affect the accuracy of the Telemetry System, the Transmitter radio frequency transmission, and cause damage to the components and circuits.

Operating Temp:	0 to +45°C (32°F to 113°F).
Storage Temp[1]:	-40 to +75°C (-40°F to 167°F).
Relative Humidity:	5 to 95%.

Dimensions and Weight

Receiver	Height:	50mm (2in).
	Width:	425mm (16.7in).
	Depth:	392mm (15.4in).
	Weight:	6.5kg (14.3 lb).
Transmitter	Height:	122mm (4.8 in).
	Width:	85mm (3.3in).
	Depth:	40mm (1.6in).
	Weight:	200g (8 oz).

(without transducers and batteries).

1. Excludes transducers. Transducers can be stored at temperatures between -40°C and +60°C (-40°F to +140°F).

Controls and Indicators

Receiver - Controls and Indicators

Description	Type	Color
Power On/Off Switch	Push Button	
Power On Light	LED	Green
Nurse Call Acknowledge/Volume Button	Push Button	
Nurse Call Light	LED	Yellow
Transmission INOP Light	LED	Yellow
Battery Low Light	LED	Yellow
Error Light	LED	Red

Transmitter - Controls and Indicators

Description	Type	Color
Power On/Off Switch	Slide Switch	
Power On Light	LED	Green
Nurse Call	Push Button	
Error Light	LED	Red

Channels and Frequencies

Over 160 different channels in the UHF Band (430-470 MHz) with 25 kHz/ 12.5 kHz channel spacing available. (See Chapter 11 for a list of the channels and frequencies available.)

Antenna

Receiver

BNC Female input connector (standard 50 Ohms input). For standalone or connection to an antenna system.

Transmitter

Built-in Antenna in US and DECG transducer cables.

Inputs

Receiver

- Equipotential Grounding Point.
- Service Socket.

Transmitter

- Cardio socket for M1356A ultrasound transducer or the M1357A/ M1364A DECG transducer.
- Toco socket for the M1355A Toco transducer or an IUP Transducer (CPJ840J5).
- Remote Event Marker and Service Socket.

Outputs

Receiver

- 25 pin RS232 Socket for connecting the Fetal Monitor.

Input Sensitivity

-118dBM

Output Power

Transmitter

4 mW (USA)

2 mW (Europe)

1 mW (Japan)

Image Rejection

>80 dB

Self-Test Facilities

Self-test facilities include:

- Receiver Self Test: Tests the Receiver LF Part.
- Transmitter Self Test: Tests the Transmitter LF Part.
- Parameter Test: With the appropriate transducer connected to the Transmitter, the monitoring mode (ultrasound/DECG or Toco/IUP) is tested from the Transmitter via Receiver to the connected Fetal Monitor.

Transducers and Cables

There are two types of Toco, Ultrasound and DECG Transducers, the Standard Series 50 and Telemetry Transducers. The Standard Transducers have a 2.5m/8ft 2in ventilated cable and the Telemetry Transducers have a 70cm/28in ventilated cable.

Both types of Toco and Ultrasound Transducers are colored blue and are watertight complying with IEC 529 (IP68)

External Blue Toco Transducers (M1355A) or (M1355A Opt. C03)

System:	Passive Straingauge.
Dynamic Range:	0 to 12N (overload protected).
Weight:	180g (6.3oz).
Cable Length:	2.5m (8ft 2in) or 70cm (28in) for Option C03.
Water-tight:	To a depth of 0.5 meters.

Blue Ultrasound Transducer (M1356A) or (M1356 Opt. C03)

System:	Pulsed Doppler.
Oscillator Frequency:	998.4kHz.
Weight:	185g (6.5oz).
Cable Length:	2.5m (8ft 2in) or 70cm (28in) for Option C03.
Size:	75mm (2.95in) diameter.
Water-tight:	To a depth of 0.5 meters.

Warning
Under no circumstances should the transducer be immersed in water when connected to the Fetal Monitor.

Caution
Blue Toco Transducers have a ventilated cable. As liquid can enter this cable through capillary action, extra care should be taken not to get the connector wet.

DECG Transducer (M1357A)

Input Impedance:	>10M (di_erential, dc to 50/60Hz).
CMRR:	>110dB (with patient cable, 51.5k/0.047_F imbalance atline frequency).
Noise:	<4_Vp (referred to input with 25k).
Contact Potential Tolerance:	_500mV.
Input Voltage Range:	20_Vp to 3mVp.
Patient Leakage Current:	<10_Arms @ 120V/60Hz.
Patient Auxiliary Current:	<0.1_A (dc).
Dielectric Strength:	2000Vrms (spark-gap protected).
Weight:	185g (6.5oz).
Cable Length:	2.5m (8ft 2in) or 70cm (28in) for Option C03.

DECG/MECG Patient Module (M1364A)

The patient module has a7-pin ECG connector into which you can plug either DECG cable (M1362A or M1362B) or MECG cable.

Overall length:	2706mm (+30, -100mm)
Length of free cable:	2618mm (+30, -100mm)
Weight:	120 grams
Size:	88x42x30mm
Socket:	DECG or MECG connection

A short cable version of the M1364A patient module with a 70 cm (28 inch) cable is orderable as part number M1364-60003.

IUP Quartz Transducer (1290C #J05)

Dynamic Range:	-50 to 300mmHg.
Sensitivity:	5_V/V/mmHg.
Non-linearity:	whichever is greater: ±1% of the reading OR ±1mmHg.
Volume Displacement:	0.2mm3/100mmHg.
Weight:	180g (6.3oz).
Cable Length:	3m (9ft 10in).
Length:	37mm (1.5in).
Height:	21.7mm (0.9in).
Operating Temp:	15 to 40_C.

IUP Pressure Transducer (CPJ840J5)

Pressure range:	-20 to + 300 mm Hg
Max. overpressure:	10,000 mm Hg
Sensitivity:	50μV/V/mm Hg
Resonance frequency:	300 Hz typical (transducer and dome)
Max. electrical excitation:	15 V DC or AC
Bridge resistance:	1000 Ohms (input and output)
Non-linearity and hysteresis:	max. 0.5% of full scale
Zero balance:	max. 0.15 mm Hg/°C
Operating temperature range:	+10 to +50°C
Storage temperature range:	-20 to +70°C
Isolation resistance:	min. 1000 MOhms
Leakage current:	max.1.5μA at 250V, 50 Hz
Weight:	24 grams (without cable)
Connector:	Equipment specified

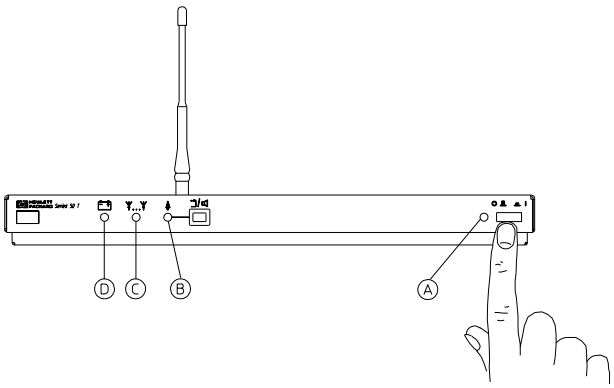
Remote Event Marker (15249A)

Length:	2.8m (9ft 2in).
Weight:	75g (2.65oz).

Testing the Receiver

To run the receiver self test:

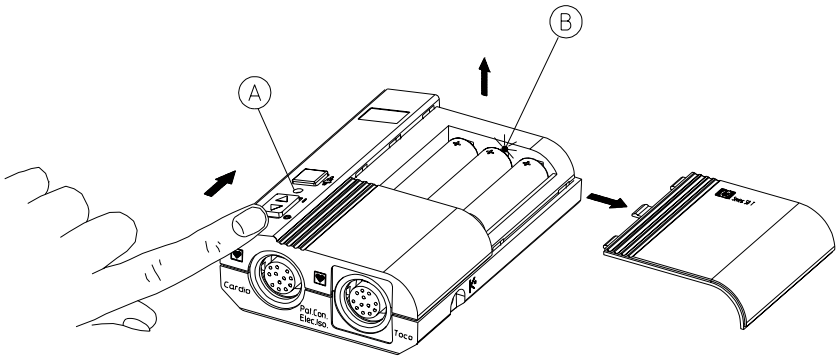
1. Switch on the fetal monitor and its recorder.
2. Press the Power On/Off button to switch the receiver on.
3. When you switch on:



- The receiver On light **(A)** comes on.
- The nurse call light **(B)** and the battery low light **(D)** are lit for one second.
- The transmission INOP light **(C)** lights and stays lit until the transmitter is switched on.
- The telemetry lamp indicator on the fetal monitor lights, indicating telemetry monitoring mode.
- TELE is annotated on the fetal trace.

Testing the Transmitter

1. Slide back the battery cover.



2. Switch on the transmitter. The green On/Off light **(A)** comes on showing the transmitter is on.

3. Check the red light **(B)** situated behind the middle battery. If:

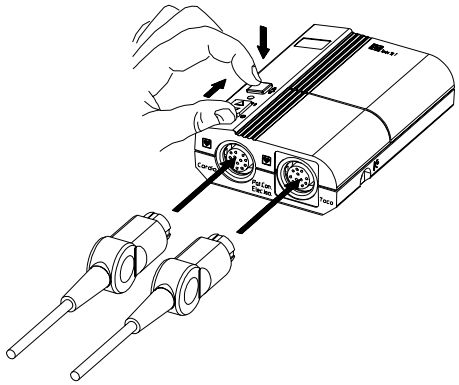
   - the red light is lit for a few seconds and then goes out, the self test is successfully complete.

   - the red light blinks, or remains on after three seconds, change the batteries. If the fault continues, there is a hardware error. See troubleshooting flowcharts in Chapter 4.

Testing the Parameter Signals

The parameter test checks the signal path to and from the transducer sockets, but not the transducers themselves.

1. Switch on the monitor, the recorder and the telemetry receiver.
2. Connect the appropriate transducer to each socket on the transmitter.
3. Standing within view of the monitor, press the Nurse Call Button on the transmitter and switch on the transmitter simultaneously. The test runs while the Nurse Call is pressed.



Signal	Correct Monitor Response
US	`125` is displayed and printed. Signal Quality Indicator is green. Fetal heartbeat is heard from the loudspeaker.
Toco	A triangle signal with an amplitude of `40` units is displayed and printed. Each cycle lasts for 12 seconds.
DECG	`150` is displayed and printed Signal Quality Indicator is green. Fetal heartbeat is heard from the loudspeaker.

If the response is different, see troubleshooting flowcharts, Chapter 4.

Error Messages

The following error messages are directly related to telemetry and appear on the fetal monitor. Refer to the *Instructions for Use* provided with your monitor for error messages not related to telemetry monitoring.

Series 50 Family

Message	Display	Cause	Solution
Err 9	US Toco	Invalid telemetry mode.	Check the cable from the telemetry receiver and, if necessary, replace it.
Err 14	US Toco	Incorrect transducer connected to transmitter.	Check that the transducer is compatible with Series 50T Fetal Telemetry System.
Err 16	US Toco	Transducers are connected to the front panel of the monitor.	Disconnect the transducers from the monitor or switch off the telemetry receiver.

8040A*

Message	Display	Cause	Solution
Err 16	US Toco	Transducers are connected to the front panel of the monitor.	Disconnect the transducers from the monitor or switch off the telemetry receiver.

*. No longer available.

8041A*

Message	Display	Cause	Solution
Signal indicator lamps flashing	Indicator Panel	Invalid telemetry mode.	Check the cable from the telemetry receiver and, if necessary, replace it.
		Incorrect transducer connected into transmitter. (Only Ultrasound and Toco transducers can be used).	Check that the transducer is compatible with Series 50T Fetal Telemetry System.
		Transducers are connected to the front panel of the monitor.	Disconnect the transducers from the monitor or switch off the telemetry receiver.

*. No longer available

4
Troubleshooting

Solving General Problems

Troubleshooting is based on the interpretation of the Receiver LED's. This chapter describes common problems and their causes, and provides troubleshooting flowcharts and guidance for their solution.

Problem	Possible Causes	Solutions
All the lights on the receiver stay on when the receiver is turned on.	Fetal monitor is switched off. Possible defect in the receiver, interface cable or fetal monitor.	Switch on fetal monitor. Carry out the tests described in "Testing the Receiver" on page 11.
The Telemetry Indicator Lamp on the fetal monitor does not light when the monitor and the receiver are switched on.	Incorrect interface connection between the monitor and the receiver. Faulty interface cable.	Follow the instructions in *Instructions for Use* for details on how to connect the monitor to the receiver. Replace interface cable.
Receiver Power On Light does not light when the receiver is switched on.	Power cable not plugged into the power supply. Fuses need replacing.	Plug in and switch on. Replace fuses.
Transmission INOP light on the receiver is still lit when the transmitter is switched on.	Receiver and transmitter do not have the same channel or serial number. Batteries in the transmitter are exhausted.	Check channel number and the serial numbers are the same on the receiver and the transmitter. Change the batteries in the transmitter (refer to the *Instructions for Use* for details.)
Battery Low Light lit on receiver.	Power in batteries is low.	Change batteries.
INOP transmission lamp is lit after the patient has moved a short distance away form the receiver.	Local Antenna: Antenna not connected correctly. Remote Antenna System: Antenna cable not connected correctly to receiver.	Check antenna is connecting correctly. Test the antenna system by bringing the transmitter close to the receiver. If the transmission is good, then the antenna system is not functioning properly.

Battery Details 3 x 1.5V Size: AA Type: LR6	Typical Battery Operating Times at Room Temperature					
	US + TOCO		DECG + TOCO		DECG + IUP	
	After Low Light Comes On	Operating Time	After Low Light Comes On	Operating Time	After Low Light Comes On	Operating Time
Alkaline (1.8 Ah)	180 min	40 hrs	100 min	16 hrs	80 min	14.5 hrs
NiCd (0.6 Ah) Rechargeable	10 min	12 hrs	6 min	5.5 hrs	5 min	4.5 hrs
NiMH (1.2 Ah) Rechargeable	20 min	22 hrs	12 min	11 hrs	10 min	9 hrs

No LEDs Lit on Receiver (continued overleaf)

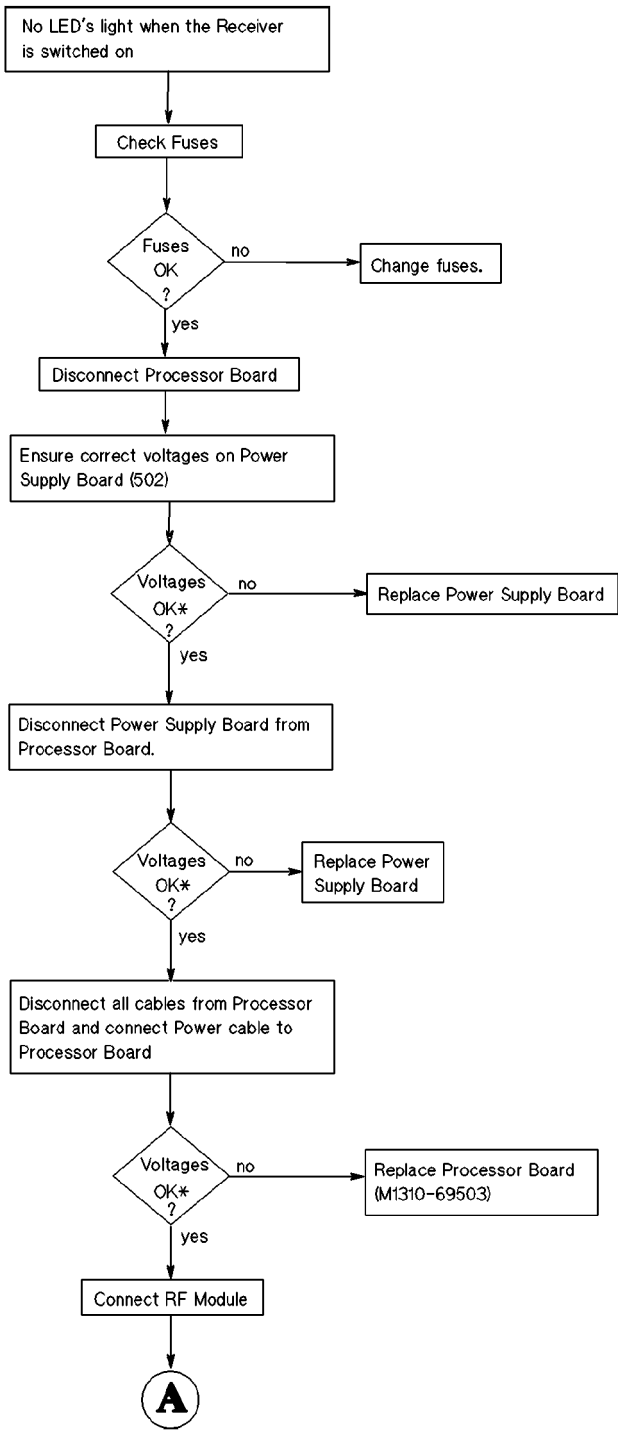


Figure 1 Troubleshooting: No LED's Lit on Receiver

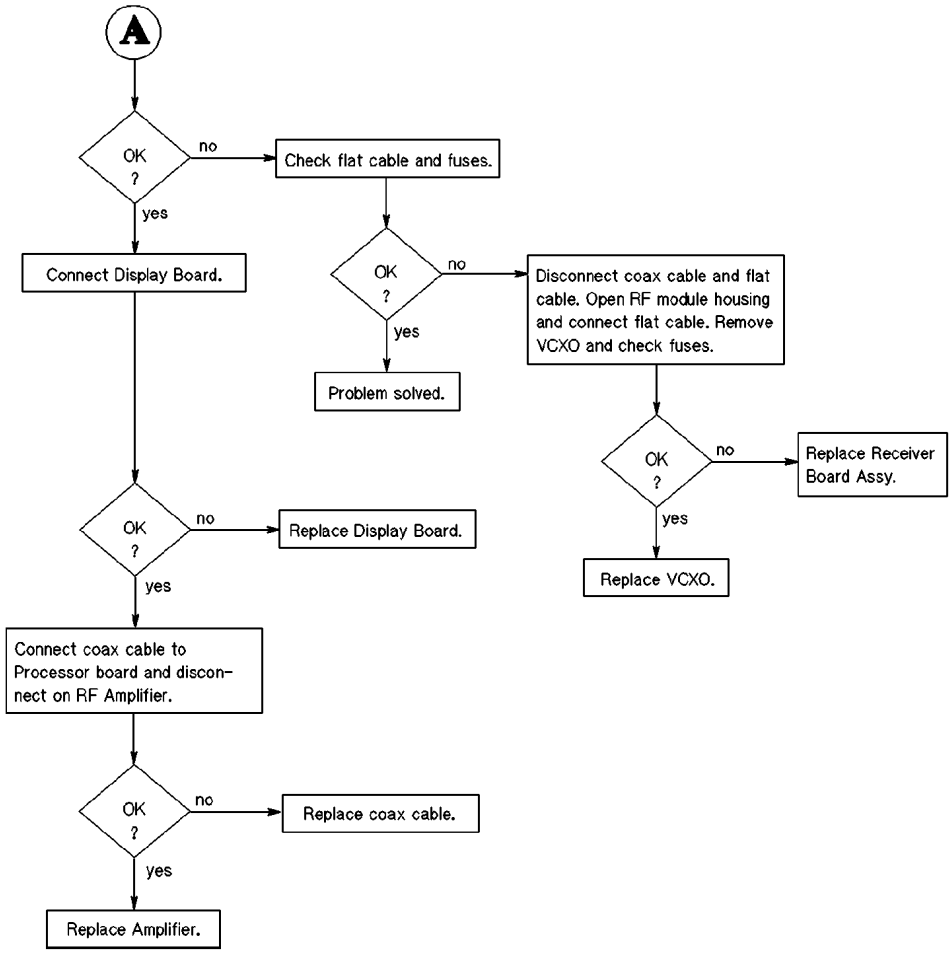


Figure 1 Troubleshooting: No LED's Lit on Receiver (continued from previous page)

Not all Receiver LEDs are Lit

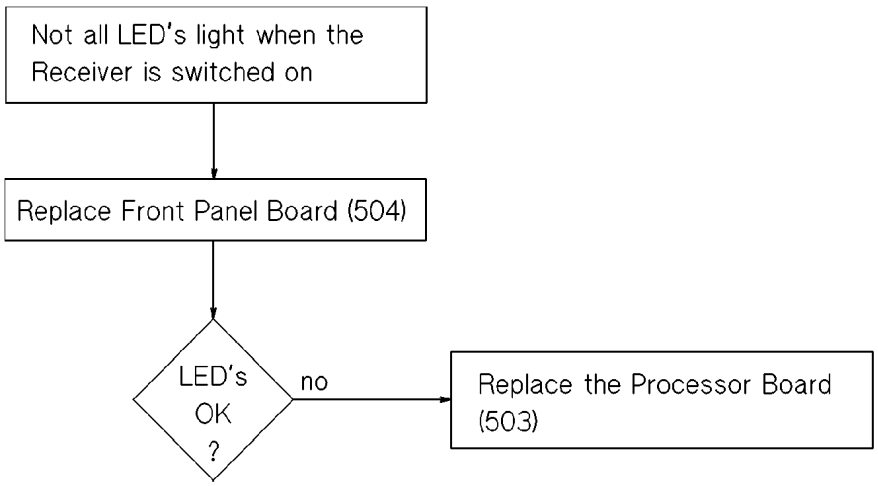

Not all LED's light when the Receiver is switched on
Replace Front Panel Board (504)
LED's OK ?
no
Replace the Processor Board (503)

Figure 2 Troubleshooting Receiver LEDs

Yellow LED Remains Lit

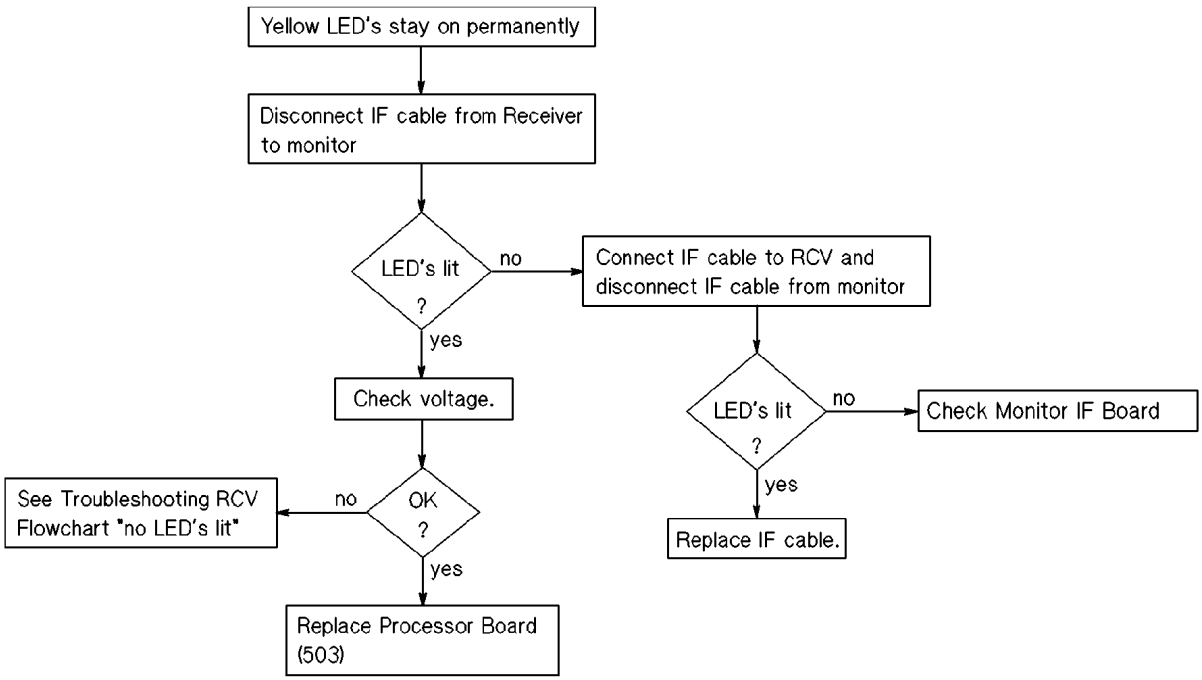


Figure 3 Troubleshooting: Yellow LED stays on

Transmission INOP Range

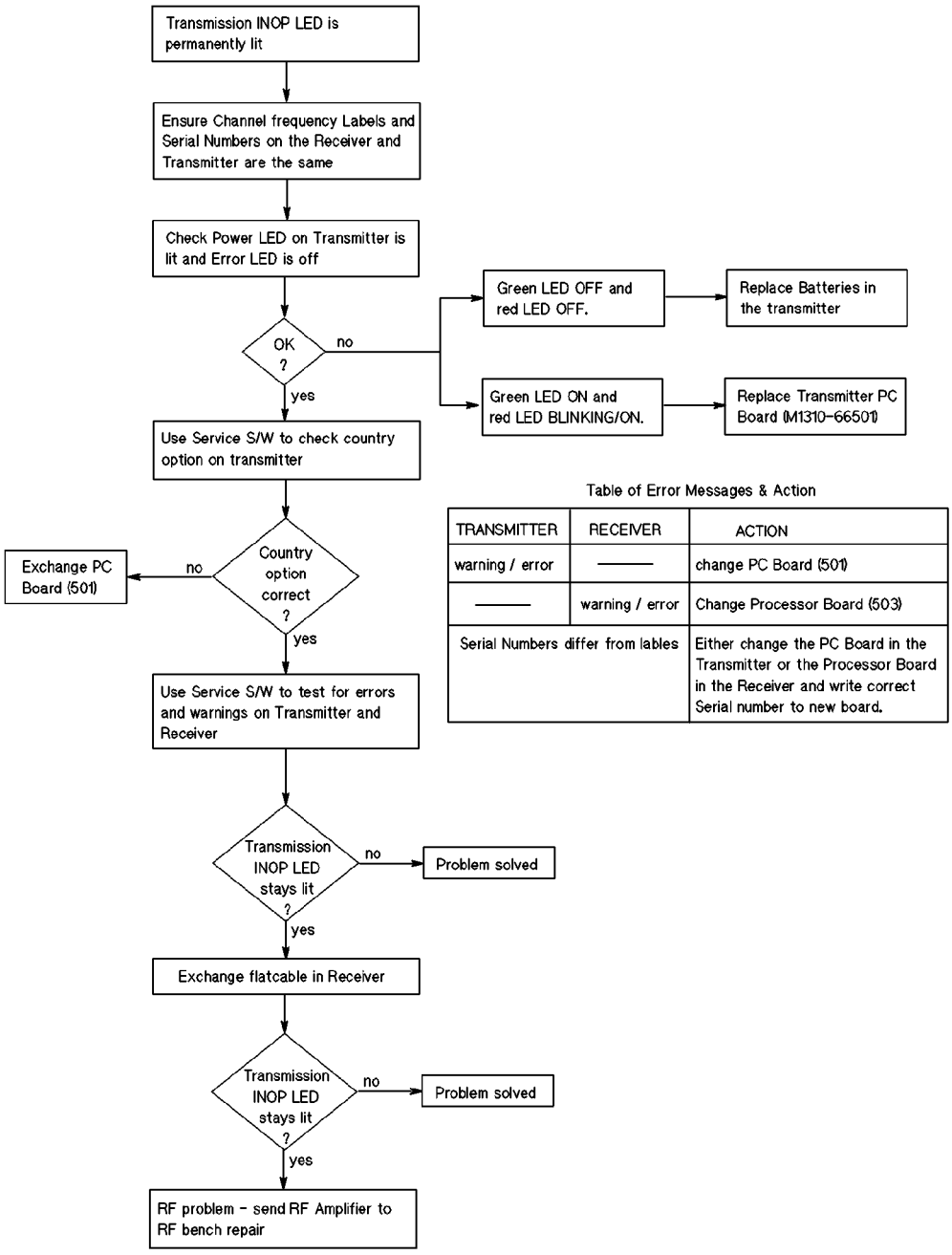

Transmission INOP LED is permanently lit
Ensure Channel frequency Labels and Serial Numbers on the Receiver and Transmitter are the same
Check Power LED on Transmitter is lit and Error LED is off
OK ?
no
yes
Green LED OFF and red LED OFF.
Replace Batteries in the transmitter
Green LED ON and red LED BLINKING/ON.
Replace Transmitter PC Board (M1310-66501)
Use Service S/W to check country option on transmitter
Country option correct ?
no
Exchange PC Board (501)
yes
Use Service S/W to test for errors and warnings on Transmitter and Receiver
Transmission INOP LED stays lit ?
no
Problem solved
yes
Exchange flatcable in Receiver
Transmission INOP LED stays lit ?
no
Problem solved
yes
RF problem - send RF Amplifier to RF bench repair
Table of Error Messages & Action
TRANSMITTER
RECEIVER
ACTION
warning / error
———
change PC Board (501)
———
warning / error
Change Processor Board (503)
Serial Numbers differ from lables
Either change the PC Board in the Transmitter or the Processor Board in the Receiver and write correct Serial number to new board.

Figure 4 Troubleshooting: Transmission INOP

Transmission Range

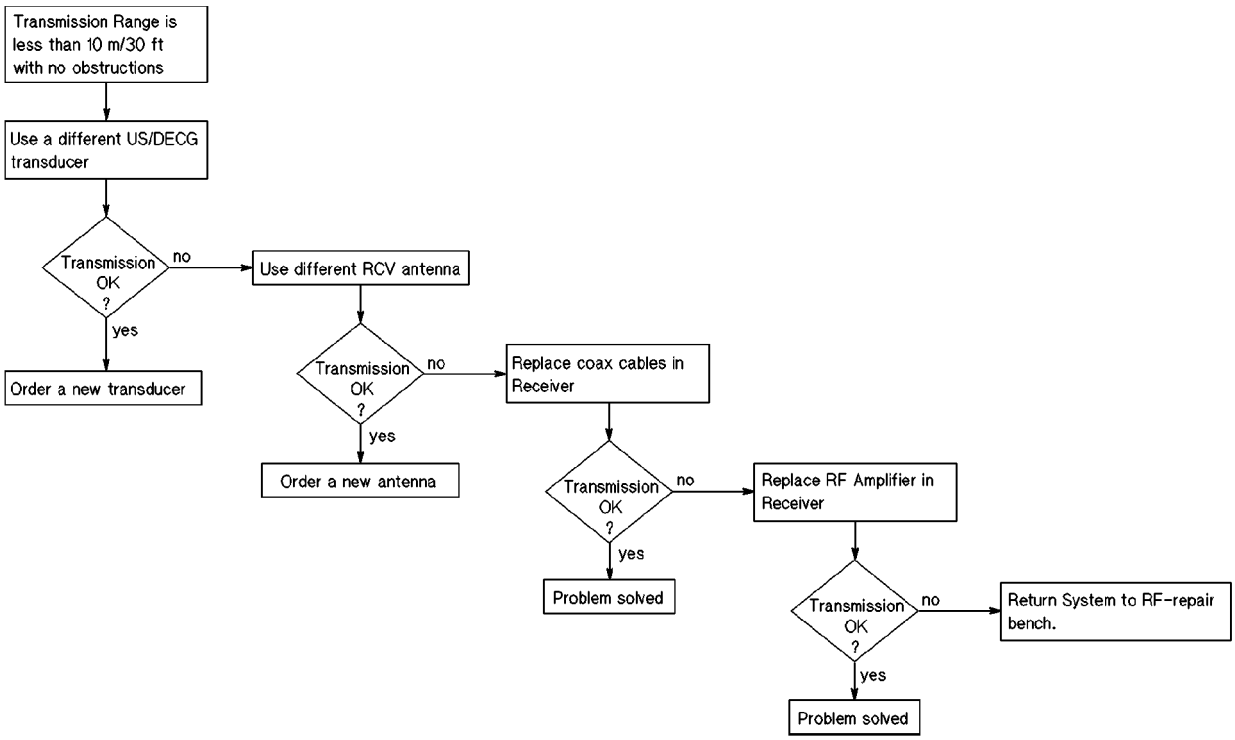


Figure 5 Troubleshooting: Transmission Range

Transducer Mode Not Detected

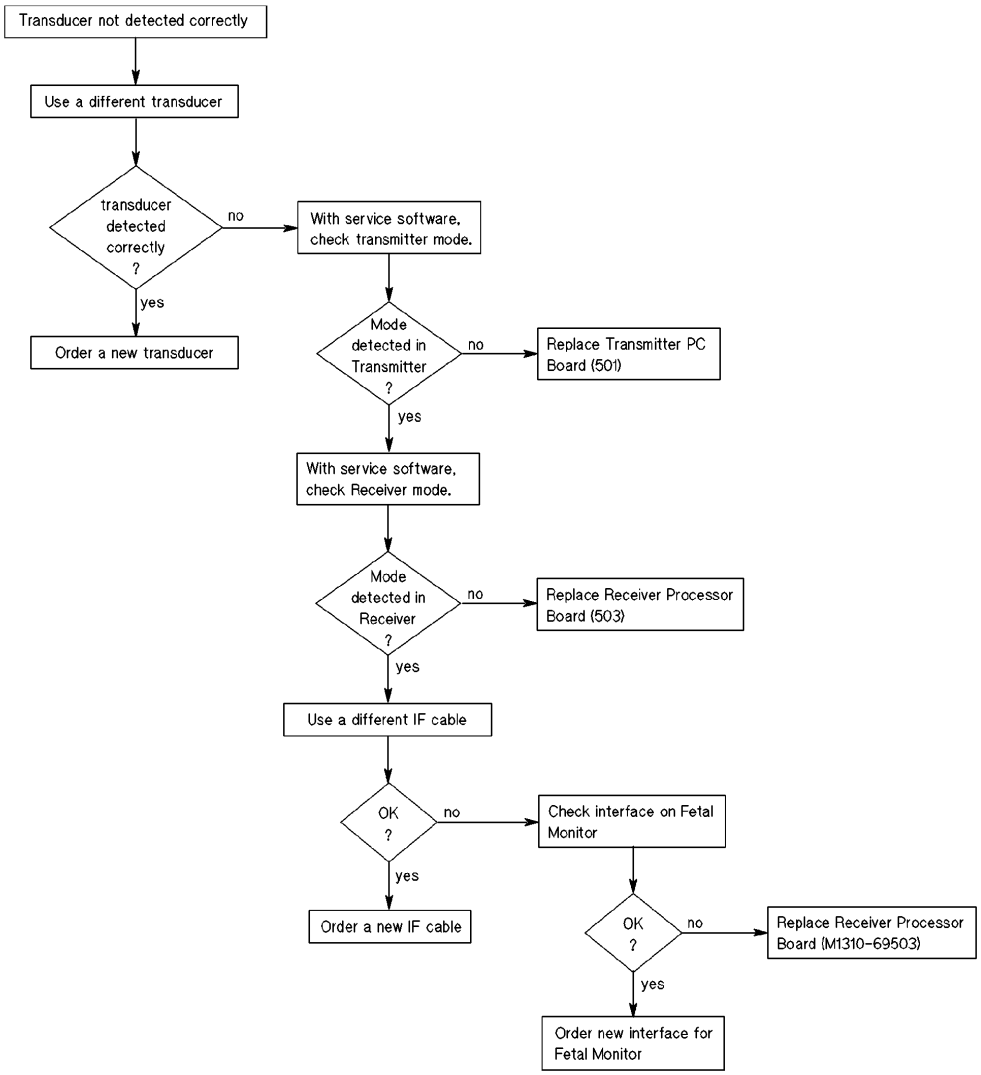


Figure 6 Troubleshooting: Transducer not detected

Cardio Channel

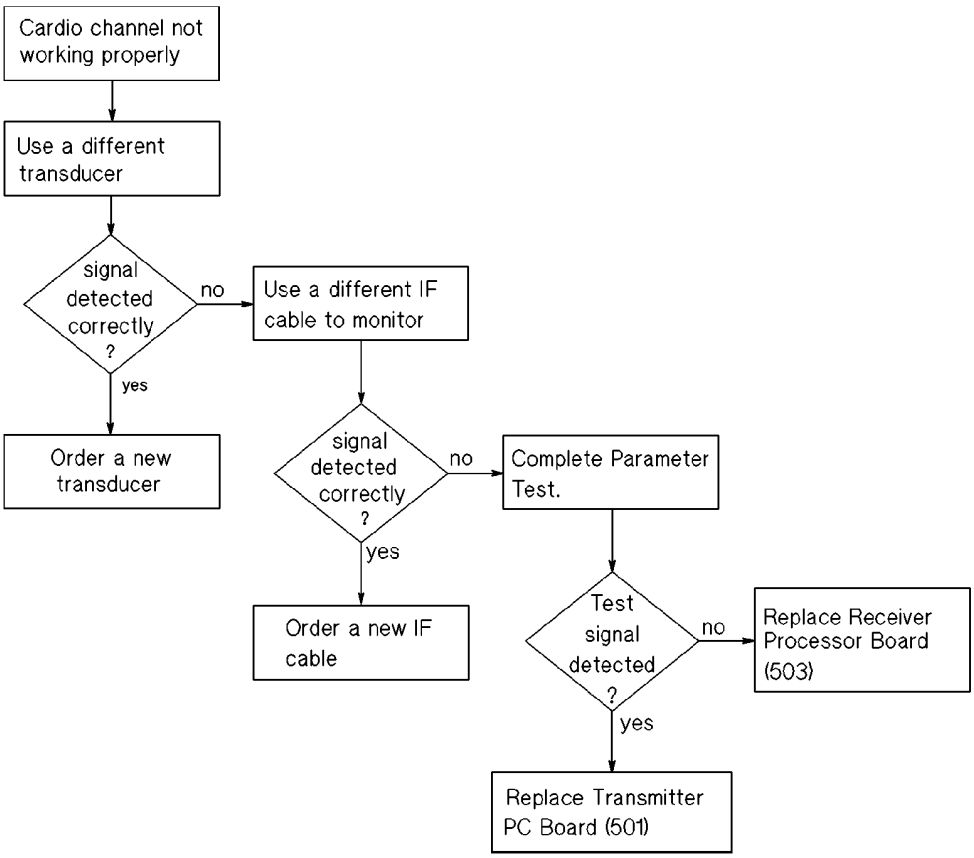


Figure 7 Troubleshooting: Cardio Channel

TOCO Channel

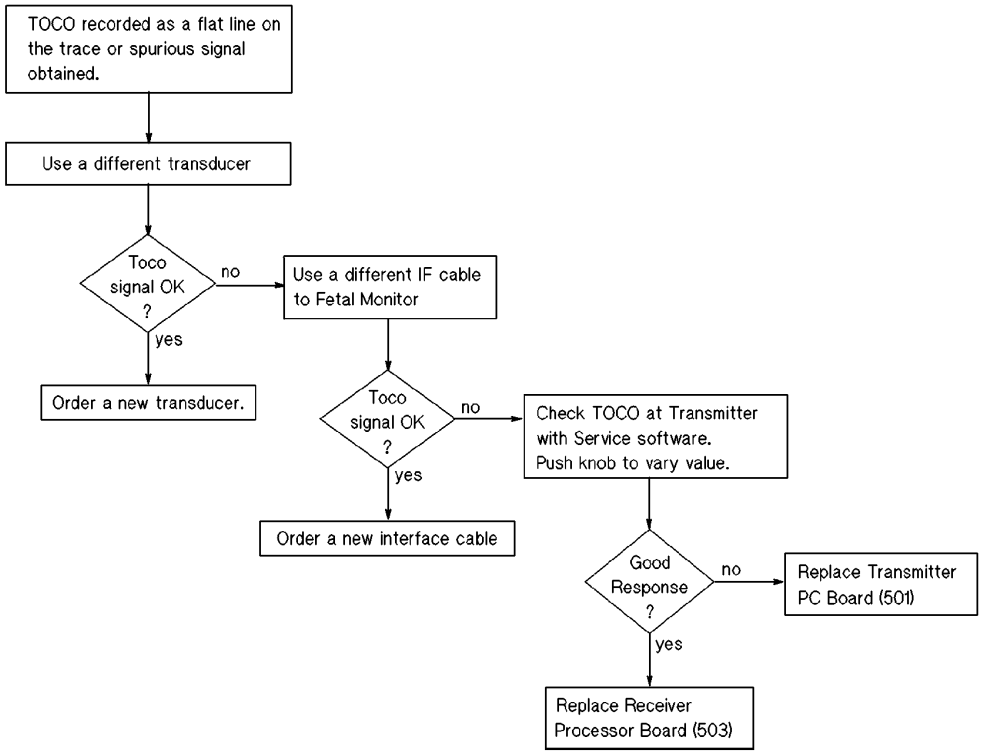

TOCO recorded as a flat line on the trace or spurious signal obtained.
Use a different transducer
Toco signal OK ?
no
Use a different IF cable to Fetal Monitor
yes
Order a new transducer.
Toco signal OK ?
no
Check TOCO at Transmitter with Service software. Push knob to vary value.
yes
Order a new interface cable
Good Response ?
no
Replace Transmitter PC Board (501)
yes
Replace Receiver Processor Board (503)

Figure 8 Troubleshooting: TOCO Channel

FMP

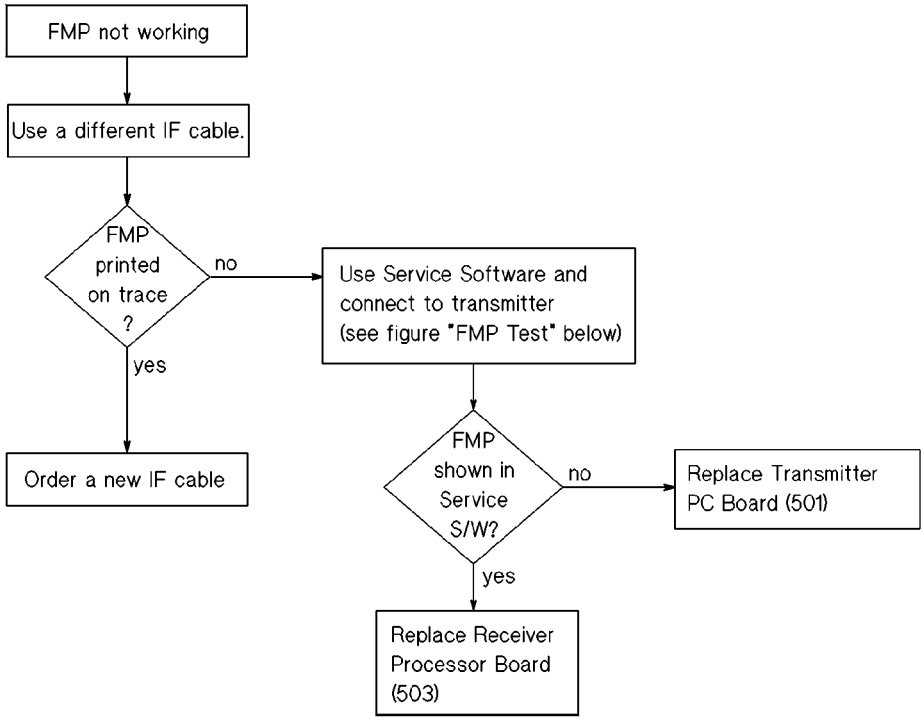

FMP not working
Use a different IF cable.
FMP printed on trace ?
no
yes
Use Service Software and connect to transmitter (see figure "FMP Test" below)
Order a new IF cable
FMP shown in Service S/W?
no
yes
Replace Transmitter PC Board (501)
Replace Receiver Processor Board (503)

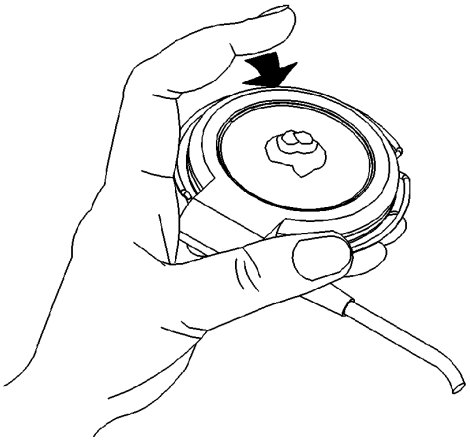
Figure 9 Troubleshooting: FMP

FMP Test

To test an ultrasound transducer:

1. Connect the telemetry receiver to the fetal monitor using the interface cable.
2. Switch on the fetal monitor, its recorder and the telemetry receiver.
3. Connect the transducer to the ultrasound socket.
4. Switch on the transmitter.
5. Increase the loudspeaker volume on the fetal monitor to an audible level.

6. Apply a small amount of gel on the transducer surface. Holding the transducer in one hand, gently tap the transducer surface with your finger.



7. You should hear a noise from the loudspeaker.

Figure 10 FMP Test

Event Marker

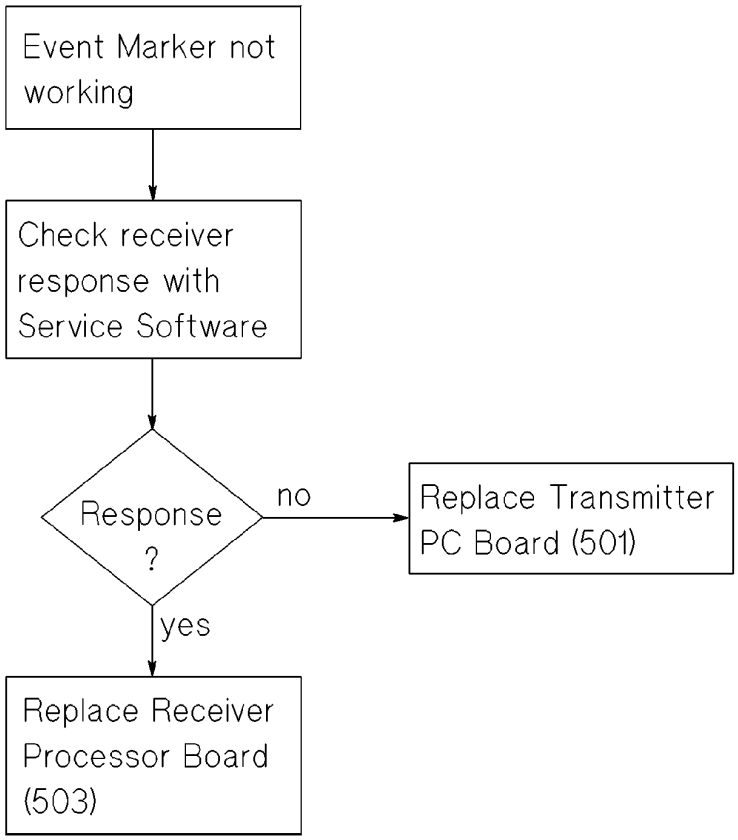


Figure 11 Troubleshooting: Event Marker

Nurse Call

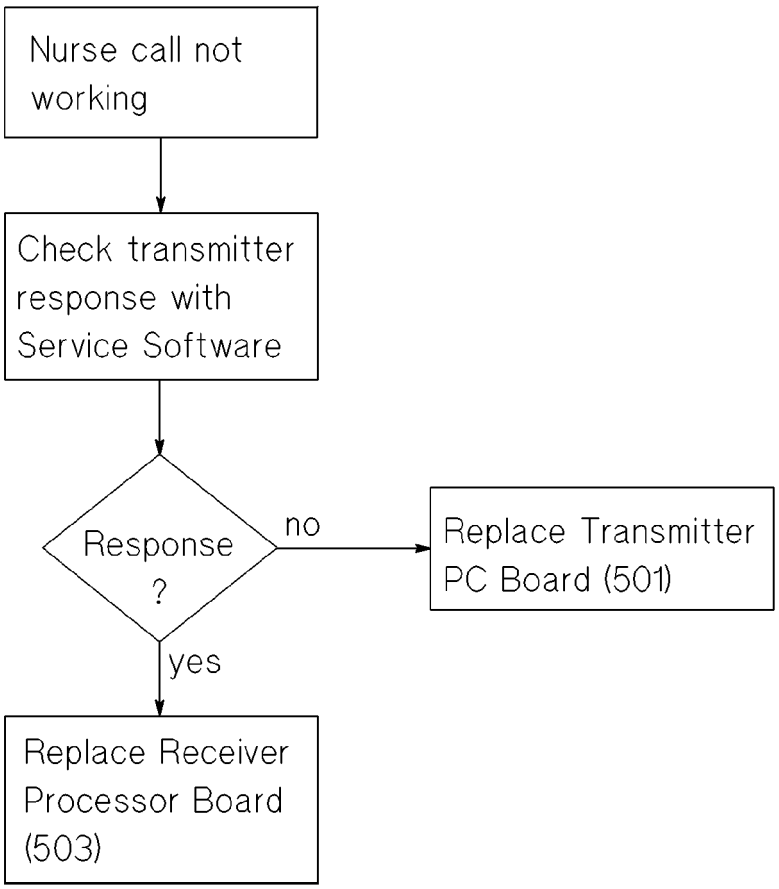
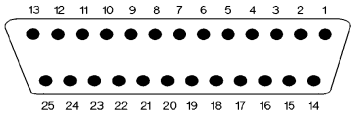


Figure 12 Troubleshooting: Nurse Call

5
Interfacing to a Fetal Monitor

The Fetal Monitor Interface on the Telemetry Receiver allows digital and analog ouputs to the Monitor. The following table lists the signals at each pin.



Pin	Signal	Details
1		Not connected.
2		Not connected.
3		Not connected.
4		Not connected.
5	nTELEon	Receiver on (L).
6		Not connected.
7	nINOP	DECG inop (L).
8	nDECG	DECG Mode (L).
9		Not connected.
10	nUS	US Mode (L).
11		Not connected.
12	nIUP	IUP Mode (L).
13	nTOCO	TOCO External Mode (L).
14	HR	US LF or ECG Signal.
15	TOCO	TOCO/IUP signal.
16	-	Not connected.
17	Gnd Analog	Analog Ground.
18	Gnd	
19	nMarker	Tele-Marker on (L).
20	nFMPon	Tele-FMP on (L) if FMP available.
21	nFMPsig	Tele-Fetal movement on (L)
22	-	Not connected
23	IF ID	**Input:** Shorted to ground with HP 8040/41A and older Series 50 Telemetry Interface. Open for enhanced Series 50 Telemetry.
24	Gnd	
25	-	Not connected.

Key: (L) means Logic signal is low (0 Volts).

Note— Status ouputs PIN 5, PIN 19, PIN 20 and PIN 21 have open collector outputs, all other status signals have 5V HCMOS level outputs.

6
Using the Service Software

Prerequisites

The Service Software runs on IBM-compatible PCs.

The latest service software for the M1310A is available from your Medical Response Center.

A cable assembly is needed to connect a PC to the Series 50 T Fetal Telemetry System. This is the same cable that is used to configure the Series 50 Fetal Monitors.

You can obtain the cable assembly by ordering M1360A-61675.

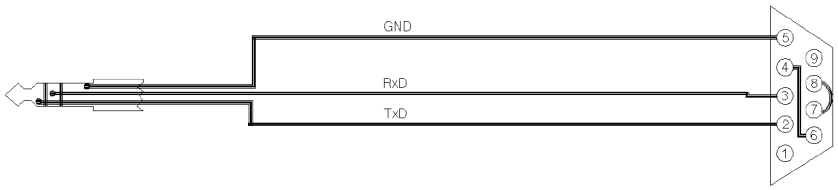


Figure 13 Cable assembly

Running the Service Software Program

To run the Service Software Program, complete the following:

Run tweetsrv.exe

You can add
- /? for HELP how to run
- /1 for COM1 (default)
- /2 for COM2
- /3 for COM3
- /4 for COM4

Example :/tweetsrv.exe /2

The example above runs the program and uses COM2.

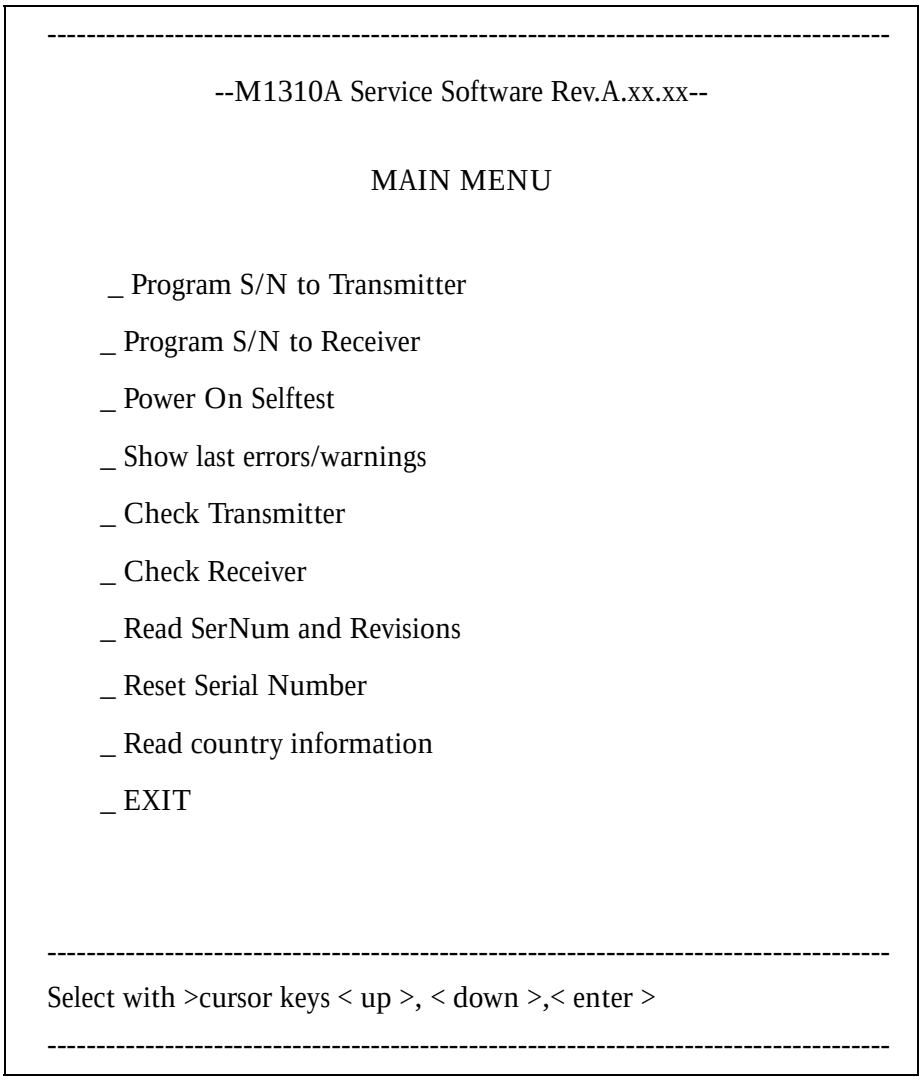
***Note*— If you have problems running the program in WINDOWS exit WINDOWS and run the program in DOS.**

Some communications programs like ‘‘llremote’’ can cause problems to start tweetsrv.exe. In this case, disconnect to release COM-port or exit WINDOWS.

Using the Service Program

When the program has been loaded onto your PC, the main menu is displayed. (If the menu is not displayed an error message is displayed along the bottom of the screen).

Main Menu



Program S/N to Transmitter

Programs the Serial Number to the Transmitter (if no Serial Number is present on the Transmitter). This feature is needed when the Transmitter Printed Circuit Board is exchanged.

Follow the steps as the program requests.

When moving the service connector from one device to the other, a "SIO RCV error" may be displayed. This is due to the PC's serial interface circuitry and can be ignored.

If a Serial Number needs to be RESET, contact the factory Technical Marketing Engineer to get RESET-CODE needed to RESET the Serial Number.

Program S/N to Receiver

Programs the Serial Number to the Receiver (if no Serial Number is present on the Receiver). This feature is needed when Receiver-PC-Bd. is exchanged.

Follow the steps as the program requests.

When moving the service connector from one device to the other, a "SIO RCV error" may be displayed. This is due to the PC's serial interface circuitry and can be ignored.

If a Serial Number needs to be RESET, contact factory Technical Marketing Engineer to get RESET-CODE to RESET the Serial Number.

Power On Selftest

The PC acts as a Terminal. The Transmitter or Receiver connected to the PC must be switched OFF and then ON. The PC displays the Start-up messages from the connected Transmitter or Receiver.

Show last errors/ warnings

Shows the summary of the received Errors and Warnings.

Check Transmitter

Provides a Transmitter check of the following:

- detected modes
- status bits
- TOCO value

Check Receiver

Provides a Receiver check of the following:

- detected modes
- status bits
- TOCO value
- RF field strength

Read SerNum and Revisions

When selected from the Main Menu, this sub-menudisplays:

- Software Revision
- Serial Protocol Revision
- Serial Number (S/N)

Reset Serial Number

This feature is only available for HP Service Personnel. It allows you to reset the Serial Number on the Transmitter or Receiver Board if the Serial Number was programmed incorrectly.To use this section a Reset-Code from a factory Technical Marketing Engineer is needed.

The Technical Marketing Engineer requires the following information:

- Serial Number (S/N)
- Transmitter OR Receiver
- Reason for RESET request

The Technical Marketing Engineer will provide you with:

The RESET-CODE.

Caution

Never erase the Serial Number from both the transmitter and the receiver, as this status is not recoverable and requires factory assistance.

Read country information

Displays the country information:

- International or
- France or
- Japan
- The RF-bandwidth
  25 kHz ++or++ 12.5 kHz
- and when JAPAN
  Japan ID-code

EXIT

Exits the program.

7
Replacing Parts

This chapter identifies the boards and replacement parts, giving their part numbers, and lists the tools you'll need to service the Series 50 T Fetal Telemetry System.

For most service tasks, it is not necessary to remove parts, and you should only dismantle the Telemetry Receiver and Transmitter as far as is necessary.

Warning
Electrical power is dangerous. Before removing any parts from the Receiver, the power to the Receiver must be disconnected.

Caution
Static electricity will damage sensitive electrical circuitry. Ensure you are adequately grounded before touching any circuit board or its associated components.

Ordering Parts

To order a part, contact your local Philips Sales/Service Office, quoting the part number listed in the tables. To order a part not listed in the tables, give the following information:

- The model number of the Telemetry System.
- The complete serial number of the Telemetry System.
- A description of the part, including its function and location.

Caution
Occasionally, as well as markings indicating manufacture by Philips, electronic components will carry standard commercial identification numbers. These components have been selected to meet specific operational criteria. Using components purchased through normal commercial channels may result in degradation of the operation performance or the reliability of the Receiver or Transmitter.

Service Tools

You should have available all the boards and parts listed in the following tables, plus the following tools:

- Small crosshead screwdriver.
- Medium slothead screwdriver.
- Large crosshead screwdriver.
- Box screwdriver (HBA).
- Spanner (M6 and M5)
- Digital Volt Meter.
- Small pincers or tweezers (useful, but not essential).

Lists of Parts

Transmitter

Transmitter Parts List

Item	Description	Part Number
1	Transmitter PC Board	M1310-69501
1	Transmitter PC Board (Singapore)	M1310-66531
1	Transmitter PC Board (Japan)	M1310-66521
2	Transmitter VCXO (2mW)	M1400-61xxx
2	Transmitter VCXO (4mW)	M1400-62xxx
2	Transmitter VCXO (1mW)	M1400-63xxx
3	Transmitter Housing Kit	M1310-64100
4	Screw HILO	0624-0761
-	Frequency Channel Label Set (not shown)	M1310-44302
-	PTT Label Set (not shown)	M1310-44303
-	Carrying belt (not shown)	M1606A

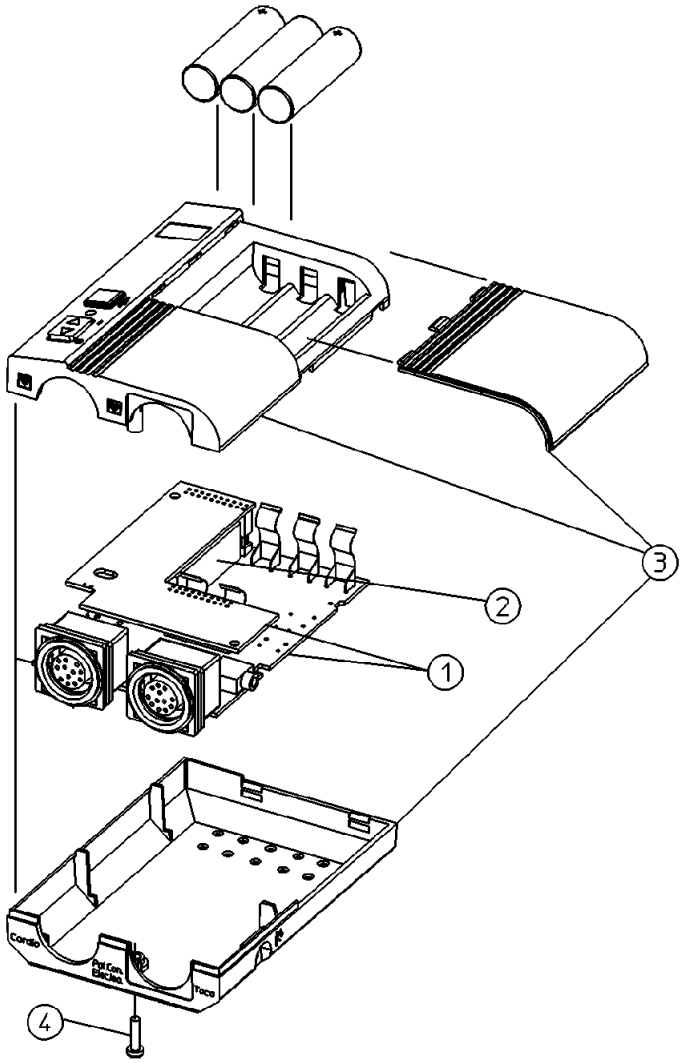


Figure 14 Transmitter Parts

Receiver

Receiver Parts List - Boards

Item	Description	Part Number
1	Power Supply Board	M1310-69502
2	Processor Board	M1310-69503
3	Frontpanel Board	M1310-66504
4	Receiver VCXO	M1402-61xxx
5	Receiver Board Assembly (Japan)	M1310-60305
5	Receiver Bd Assy. NEW 430-440MHz	M1402-60304
5	Receiver Bd Assy. EXCH 430-440MHz	M1402-68304
5	Receiver Bd Assy. NEW 440-450MHz	M1402-60305
5	Receiver Bd Assy. EXCH 440-450MHz	M1402-68305
5	Receiver Bd Assy. NEW 450-460MHz	M1402-60306
5	Receiver Bd Assy. EXCH 450-460MHz	M1402-68306
5	Receiver Bd Assy. NEW 460-470MHz	M1402-60307
5	Receiver Bd Assy. EXCH 460-470MHz	M1402-68307
5	Receiver Bd Assy. NEW 470-480MHz	M1402-60308
5	Receiver Bd Assy. EXCH 470-480MHz	M1402-68308
6	RF Amplifier Board	M1406-60560

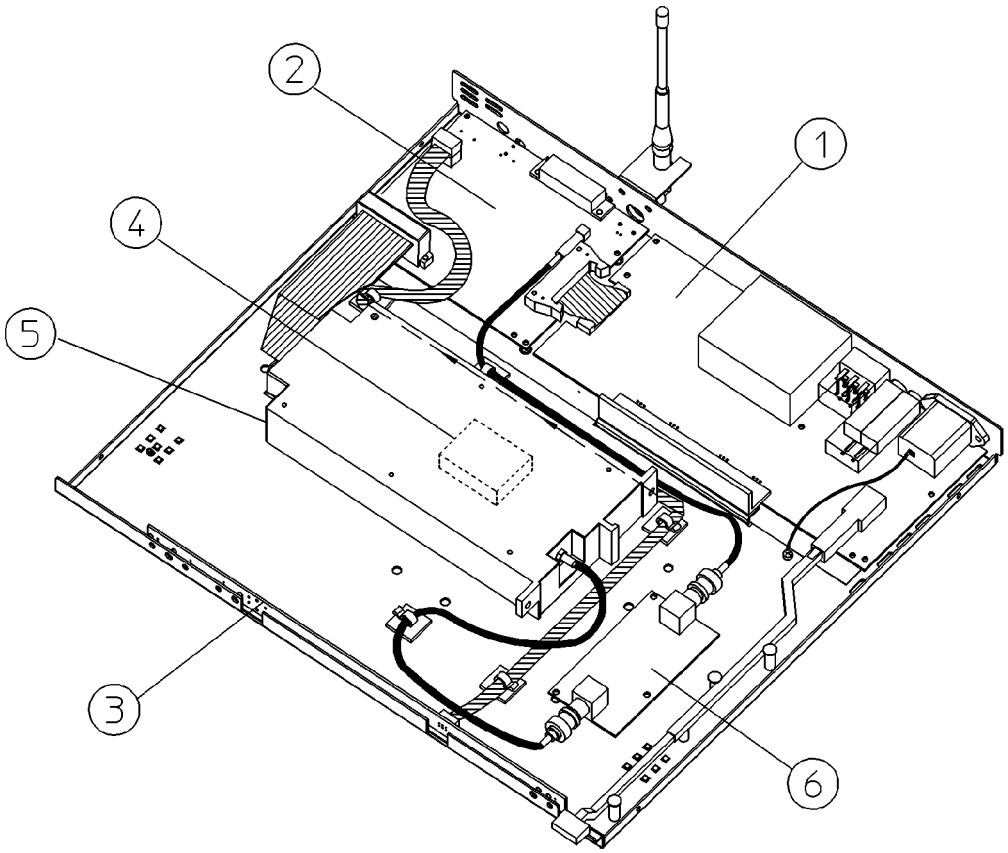


Figure 15 Receiver Boards

Receiver Parts List

Item	Description	Part Number
1	Coax Cable Assembly	8120-6413
2	Flat Cable Assembly (48 pin)	8120-6414
3	Antenna 450-512 MHz	0950-2028
3	Antenna 406-450 MHz	0950-2029
4	BNC-Connector 90 deg.	1250-0076
5	Power SW Manipulator	5040-9317
6	Power SW Knob	5040-1203
7	Receiver Housing Kit	M1310-64551
8	Fuse T300mA/UL	2110-0044
8	Fuse L125/IEC	2110-0488
9	Fuse Holder Cap/UL	2110-0565
9	Fuse Holder Cap/IEC	2110-0567
10	Ground Pin	1251-5964
11	Washer	2190-0676
12	Plastic Plug for Receiver Top	6960-0016
-	Foot for Receiver Housing (not shown)	5041-4264
-	IF Cable to Fetal Monitor (not shown)	M1310-61601
-	Receiver Wallmounting Kit (not shown)	M1310-64150

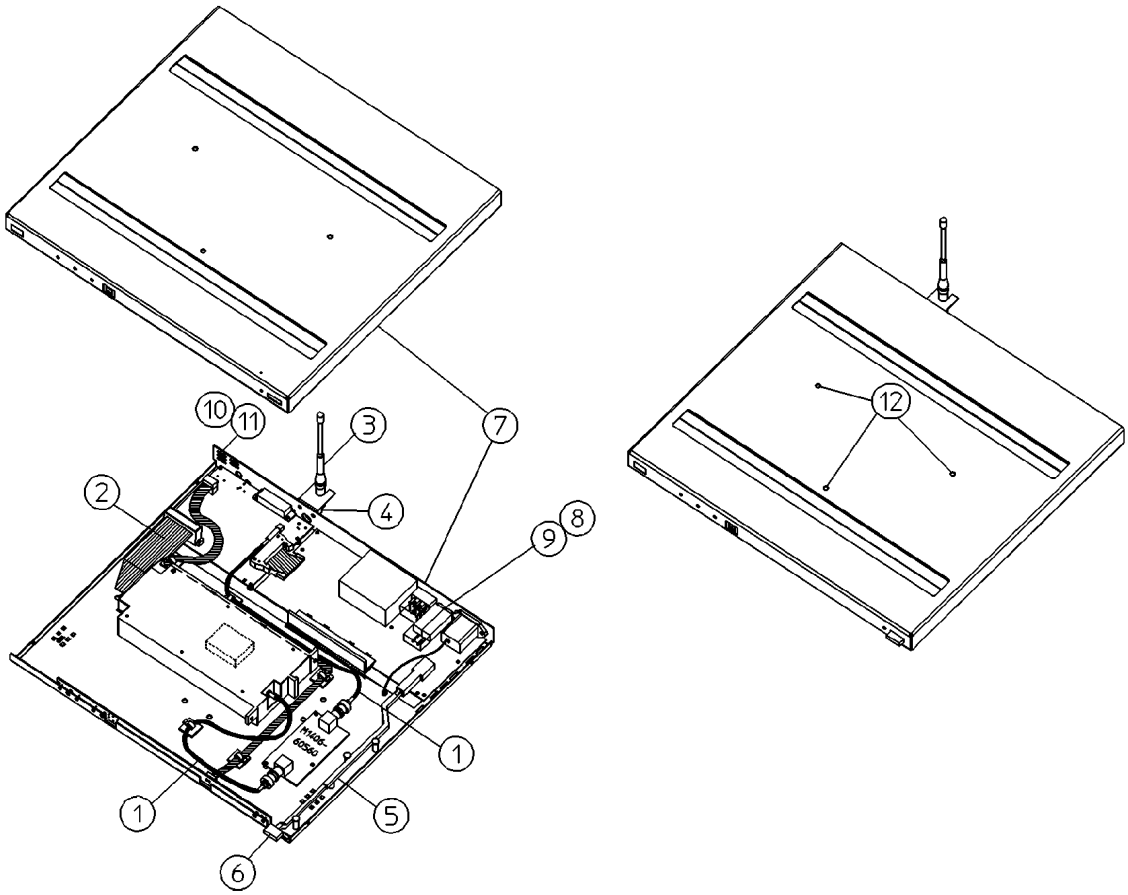


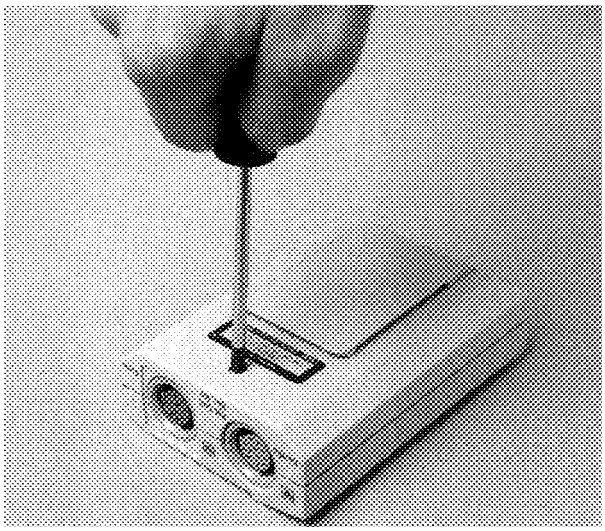
Figure 16 Receiver Parts

Transducers

Description	Part Number
Toco with 70cm Cable	M1355-69013
US with 70cm Cable	M1356-69013
DECG with 70cm Cable	M1364-60003

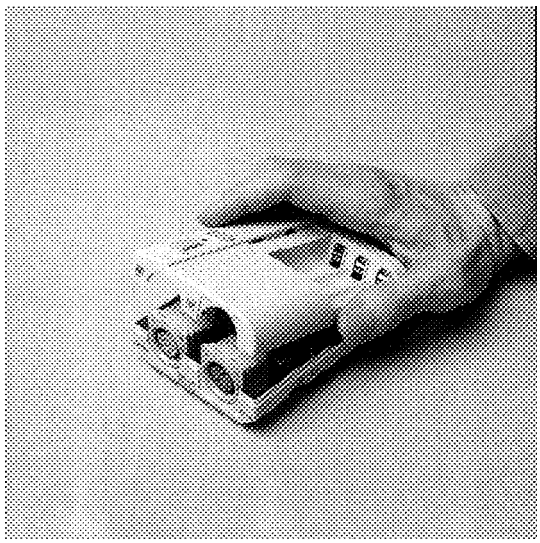
Dismantling the Transmitter

1. Remove the batteries from the battery compartment.
2. Turn the transmitter upside down and, using a small crosshead screwdriver, undo the screw.



Removing screw on Transmitter Housing

3. Turn the transmitter over and lift off the top of the transmitter housing.

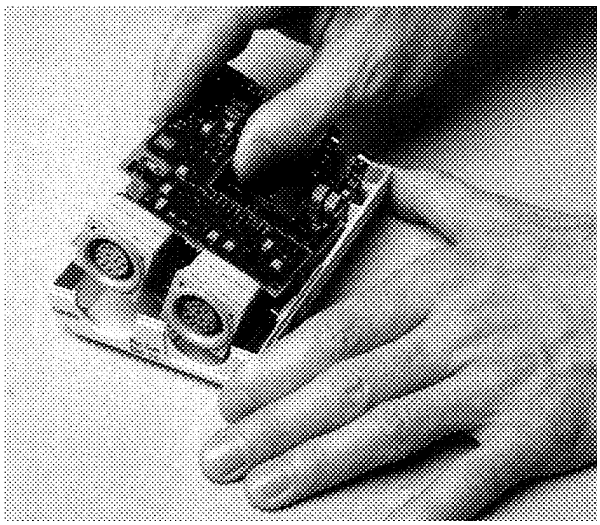


Removing Top of Transmitter Housing

Transmitter Processor Board

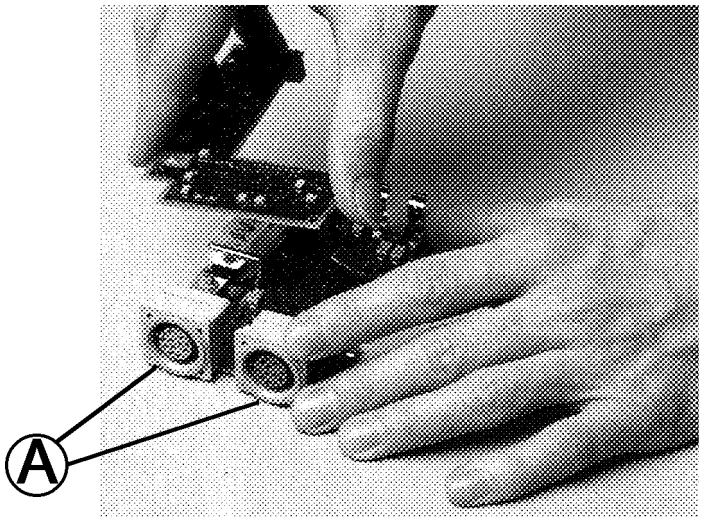
To remove the Transmitter Processor Board, follow the instructions for dismantling the transmitter then:

1. Remove the complete assembly from housing by lifting it out from the cardio connector side first.



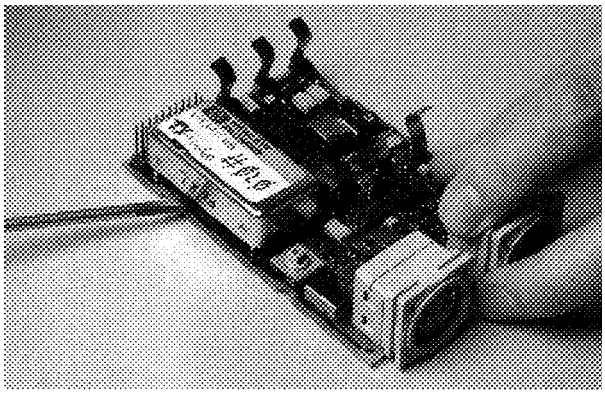
Lifting out Assembly.

2. With your hand apply gentle upward pressure in a rocking motion to seperate the top board from the bottom board.
3. Remove the Cardio and Toco socket rings **(A)**.



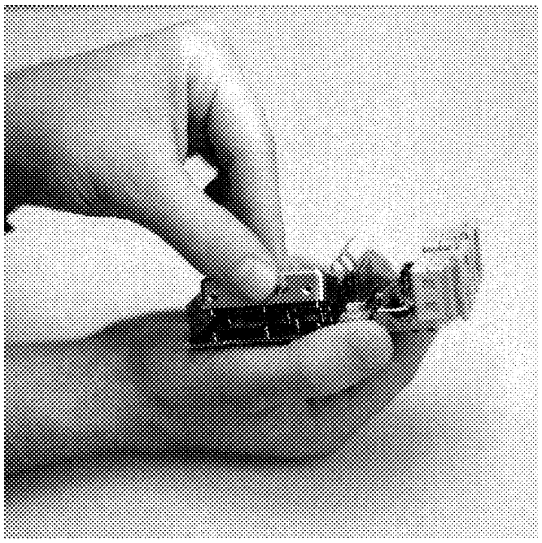
Separating the Boards.

4. Using a small flat bladed screwdriver, carefully prise the VCXO off the board. Do not lean or put excessive pressure upon the board as it contains sensitive components which can be easily damaged.



Removing the VCXO

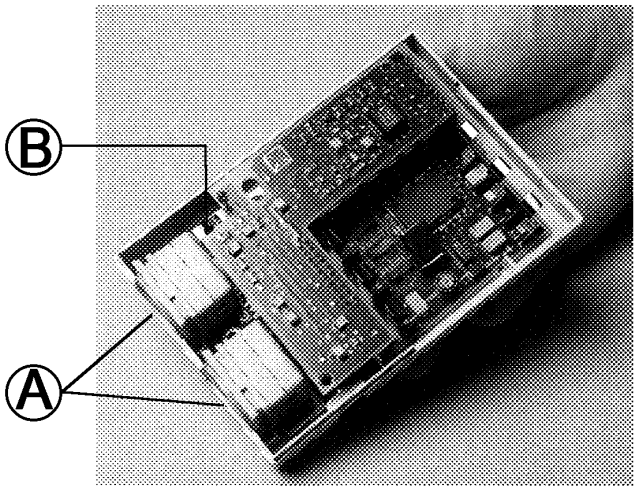
5. To fit the replacement part, angle the new VCXO and locate its pins in one side of the socket. Holding the board in your hand, carefully seat the VCXO until it is securely in position. Excessive pressure exerted onto the lower board may damage delecate components.



Replacing the VCXO

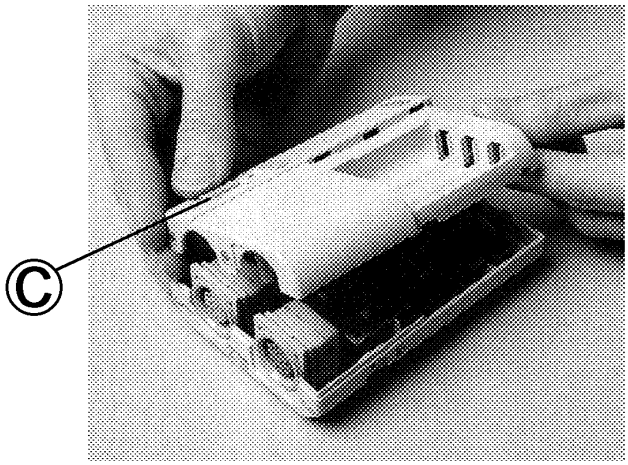
6. Holding the lower board in your hand reconnect the top board.

7. Replace connector rings to the Cardio and Toco sockets **(A)**.
8. Ensure that the on/off switch manipulator **(B)** is in the off position.
9. Insert board into housing at an angle, Toco side first.



Re-Assembling the Transmitter

10. Ensure power on/off switch is at 0 **(C)**.



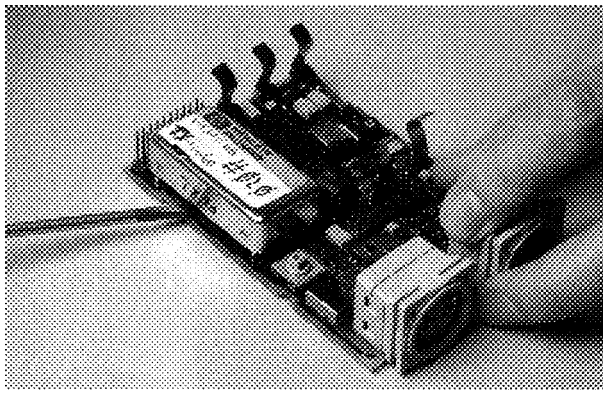
Replacing the Housing

11. Replace the top part of the housing and snap the 2 parts together.
12. Check On/Off switch mechanism is in the O (off) position.
13. Screw together carefully (do not fully tighten).
14. Replace the batteries.
15. Switch on and ensure that the green On LED is lit. Also check the red LED inside the battery compartment by lifting the battery cover (the red LED is situated behind the middle battery).
16. Use the service software to set the transmitter serial number. The serial number should be the same as the number on the label on the rear of the transmitter.

Transmitter VCXO

To remove the Transmitter VCXO, follow the instructions at the beginning of this chapter for dismantling the Transmitter then:

1. Take out complete assembly from housing by lifting from the cardio side.
2. Lift top board from bottom board by lifting from the cardio side.
3. Remove the Cardio and Toco socket rings.
4. Seperate the top board from the bottom board.
5. Using a suitable flat bladed screwdriver, carefully prise the VCXO out of the board.This task must be done carefully as excessive pressure exerted upon the board may damage delicate components.
6. See Chapter 8 for details of RF Bench Repair Test.



Removing the VCXO

When the replacment VCXO is received:

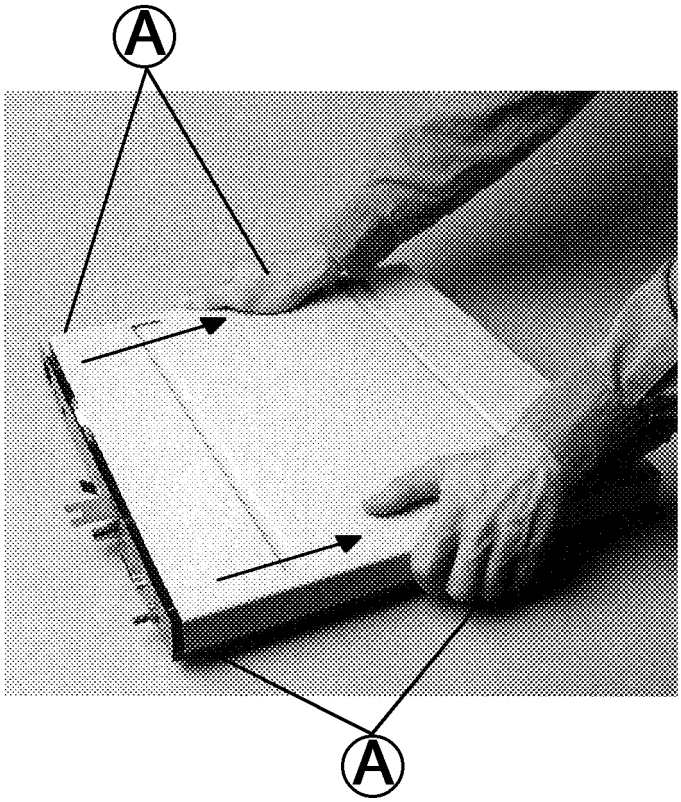
1. To fit the replacement part, angle the new VCXO and locate its pins in one side of the socket. Holding the board in your hand, carefully seat the VCXO, applying gentle pressure until it is securely in position. Excessive pressure exerted onto the lower board may damage delicate components.
2. Connect the top board to the lower board.
3. Replace the connector rings onto the cardio and toco sockets.
4. Insert the board into the housing at an angle, Toco side first.

5. Check switch mechanism is set at O (off).
6. Connect the top housing to the bottom housing and snap the two parts together.
7. Screw the housing together carefully (do not press hard).
8. Replace the batteries.
9. Switch on and ensure that the green On LED is lit. Also check the red LED inside the battery compartment (situated behind the middle battery) by lifting the battery cover.

Dismantling the Receiver

To dismantle the Receiver:

1. Turn the Receiver off and disconnect from power supply.
2. Remove antenna.
3. Remove 4 screws **(A)**.
4. Slide top cover from back to front until it stops.
5. Lift off.



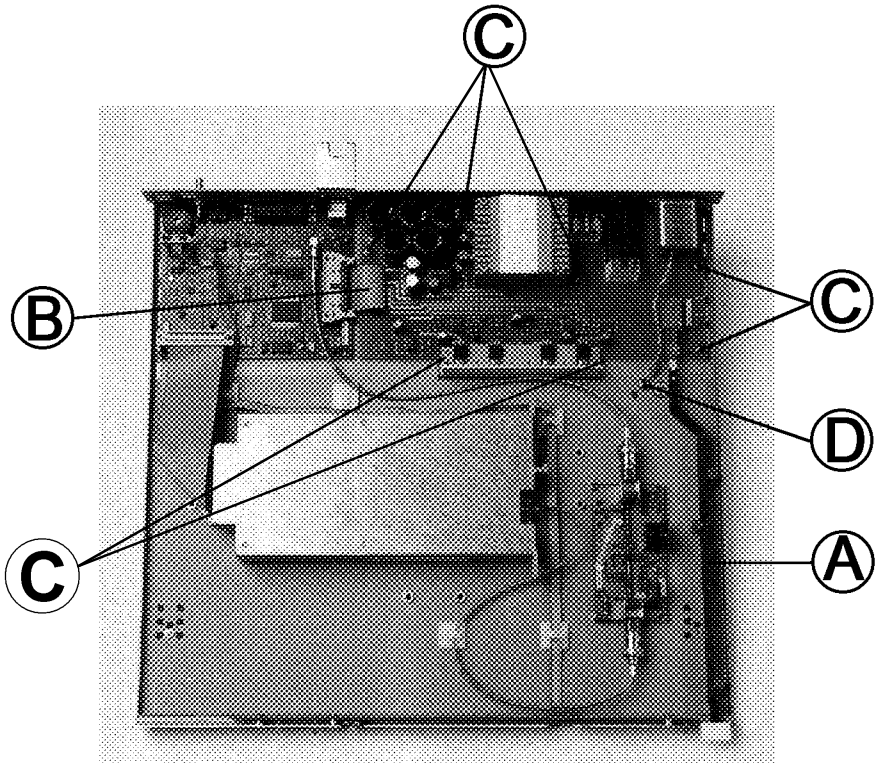
Dismantling the Receiver

***Note*— Cases with spacers are not interchangable with those earlier models that do not have them fitted.**

Power Supply Board

To remove the Power Supply Board, first, follwing the instructions for dismantling the Receiver, then:

1. Remove power switch manipulator **(A)**.
2. Remove flat cable from processor board **(B)**.
3. Remove 7 screws **(C)**.
4. Remove ground cable. Keep the ground cable screw-washer in a safe place. **(D)**
5. Lift clear of the housing.



Removing the Power Supply Board

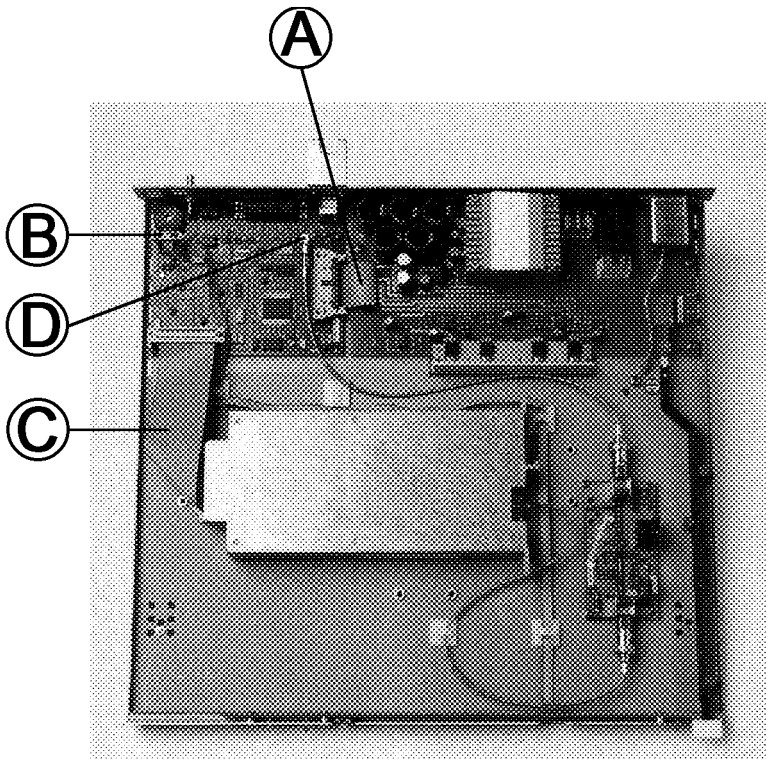
To replace the Power Supply Board:

1. Put power supply board into place.
2. Attach the power supply board with the 8 screws.

3. Reconnect the ground cable with screw and washer.
4. Reconnect the flat cable from the processor board.
5. Connect power switch manipulator.

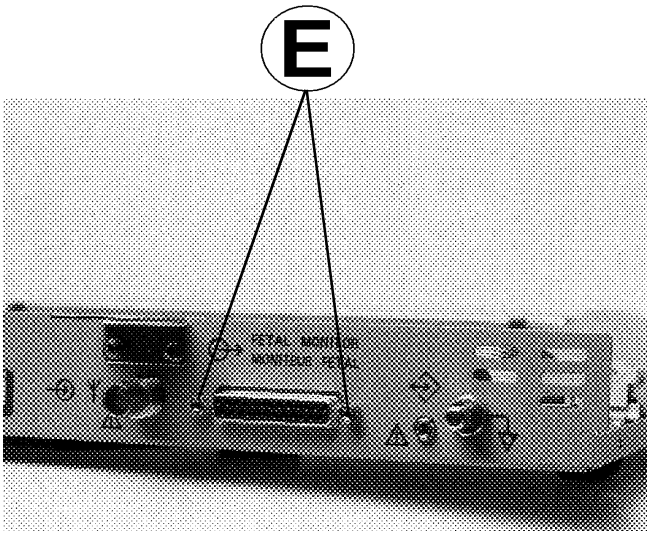
Processor Board

To remove the Processor Board, first follow the instructions for dismantling the Receiver, then:



Removing the Processor Board

1. Remove the flat cable to the Power Supply Board **(A)**.
2. Remove the cable to the Front Panel Board **(B)**.
3. Remove the flat cable connector **(C)**.
4. Using a M6 spanner, remove the coax cable **(D)**.
5. Using a M5 spanner, remove the 2 hexagonal screws **(E)** at the 25 pin D type connector. (See next picture).



Removing the Hexagonal Screws

6. Remove 4 screws.
7. Lift out Processor Board.

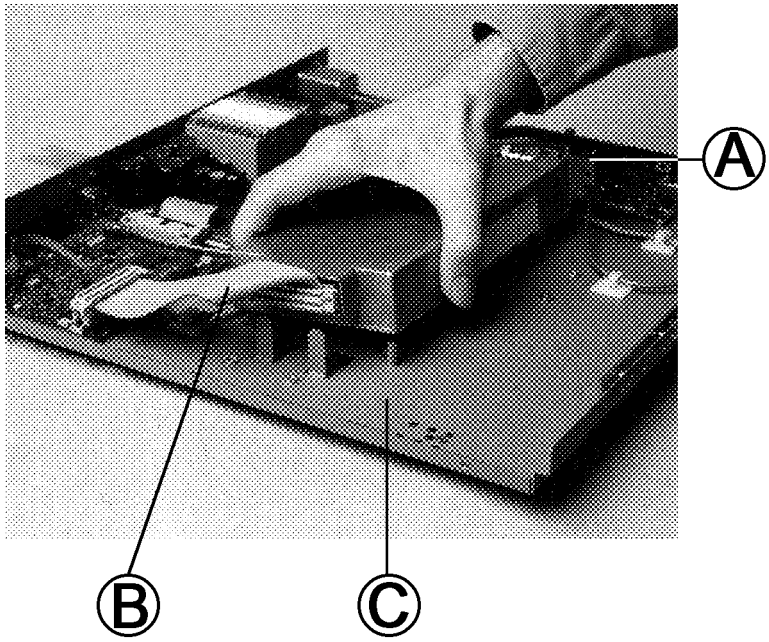
To replace the Processor Board:

1. Replace the 4 screws which hold the Processor board and tighten them (not completely) so the board can still move.
2. Replace the 2 hexagonal screws **(E)** at back of monitor, screwing them in tightly.
3. Tighten the 4 screws so the Processor board is held firmly.
4. Reconnect and tighten the coax cable with M6 spanner.
5. Reconnect all cables.

RF Module

To remove the RF Module, first follow the instructions for dismantling the Receiver, then:

1. Disconnect the flat cable **(B)**.
2. Remove the coax cable from the Receiver Board Assembly with M6 spanner **(A)**.
3. Lift the Receiver Board Assembly clear of the casing **(C)**.



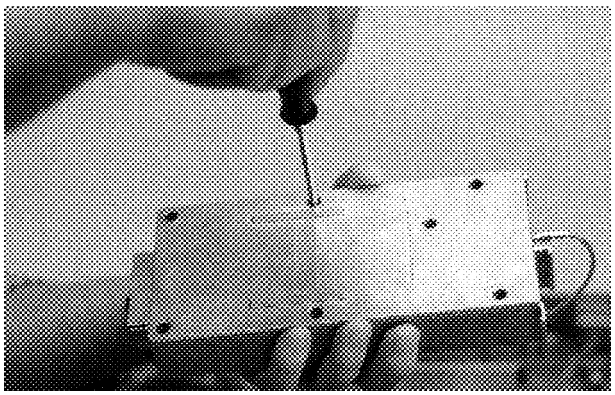
Removing the RF Module

***Note*— Do not forget to remove the RCV-VCXO from the defective Receiver Assembly**

To replace the RF Module, reverse the above procedure. For details of the RF Bench Repair see Chapter 8.

Receiver VCXO

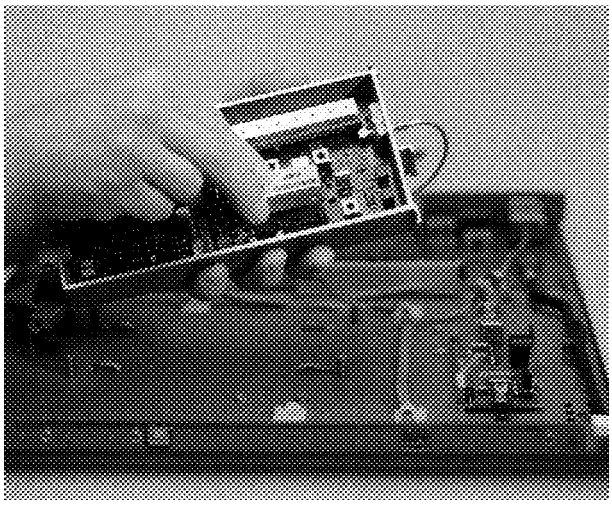
1. Remove the 7 screws on the underside of the Receiver Board Assembly and remove the cover.



Opening the RF Module Cover

2. Using a small flat bladed screw driver, carefully prise the VCXO off the Receiver Board Assembly.

3. When fitting the replacement VCXO, angle the new part and locate its pins in one side of the socket. Carefully seat the VCXO, applying gentle pressure until it is securely in position.



Fitting the VCXO to RF Module

To replace the RF module, reverse the above procedure.

RF Amplifier

To remove the RF Amplifier, first follow the instructions for dismantling the Receiver, then:

1. Remove the 3 screws that hold the RF Amplifier Board.
2. Disconnect the coax cables.
3. Lift the RF Amplifier clear of the casing.

To replace the RF Amplifier, reverse the above procedure.

Display Board

To remove the Display Board, first follow the instructions for dismantling the Receiver, then:

1. Remove the small flat cable from the Display Board.
2. Remove the 3 screws which hold the Display Board.
3. Lift the Display Board clear.

To replace the Display Board, reverse the above procedure.

Fuses

The fuse values are printed beside the mains socket:

For 100-120V ~ Line Voltage T300mA 250V ~ UL

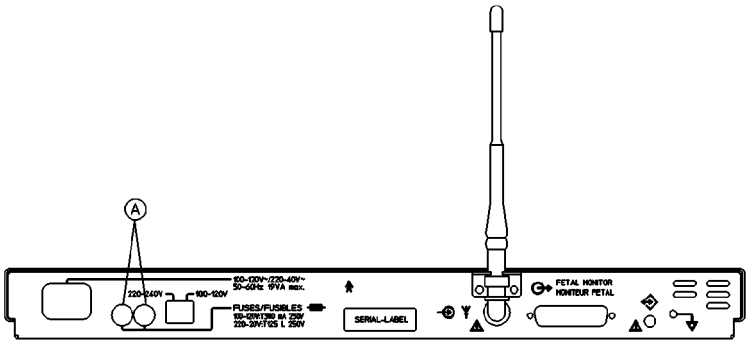
For 220-240V ~ Line Voltage T125 L 250V ~ IEC

(~ = alternating current)

For part numbers see the Receiver parts list.

To replace the fuses:

1. Switch off the Receiver and disconnect it from the main power supply.



2. Using a flat-blade screwdriver, turn the fuse cover **(A)** anti-clockwise.
3. Pull out the fuse holder and fuse.
4. Remove the fuse from the holder and replace it with another of the correct value.
5. Slide the holder and fuse back into place.
6. Using a flat bladed screwdriver press in the fuse cover and simultaneously turn the cover clockwise.
7. Repeat steps 2 and 6 for the second fuse.

8
RF Bench Repair

Introduction

RF Bench Repair should be performed when the low-frequency sections of the Series 50 T Transmitter and Receiver have passed the tests in the Troubleshooting Flowcharts Chapter 4 with no problems. RF associated Transmitter and Receiver problems should be identified and resolved using the RF Bench Test.

Caution

Static electricity will damage sensitive electrical circuitry. Ensure you are adequately grounded before touching any circuit board or its associated components.

What You Need

The following equipment is required to perform the test and repair:

Equipment	Requirements	Example
Oscilloscope	>10MHz, 100 mV min	HP54601A
Active Probe	500 MHz (min.)	HP1120A
Spectrum Analyzer	100 Hz to 500 MHz (min) Freq. Accur.:<2ppm	HP8568B
Signal Generator	500 MHz (min.)	HP8640B
2 BNC Cables	50 Ohms 0.7 to 1.5m long	HP10503A
BNC Adapter	50 Ohms	1250-0080
AC coupler	0.18uF, 200V	10240B

The goal of the RF Bench Test is to find out which of the following sections is defective:

Transmitter VCXO (M1400-6xxxx)
Receiver Preamplifier Board (M1406-60560)
Receiver Assembly (M1402-6x30x)
Receiver VCXO (M1402-61xxx)

If the operating range is decreased or no transmission is possible, the following tests given in this chapter should be performed.

Transmitter VCXO Test

1. Open the battery compartment of the Transmitter and remove the batteries.
2. Turn over the transmitter and remove the screw.
3. Pull up the housing top and lift out the Transmitter Board Assembly from the bottom housing.
4. Place the Transmitter Board Assembly into housing top again and load the batteries. Ensure the power switch manipulator is in the off position.
5. Switch on the Transmitter.

***Note*— Ensure that no Transducers are connected to the Cardio or Toco Sockets.**

6. Connect an Oscilloscope (1 MOhms input impedance).
7. Ground to the marked ground point and the probe to position.

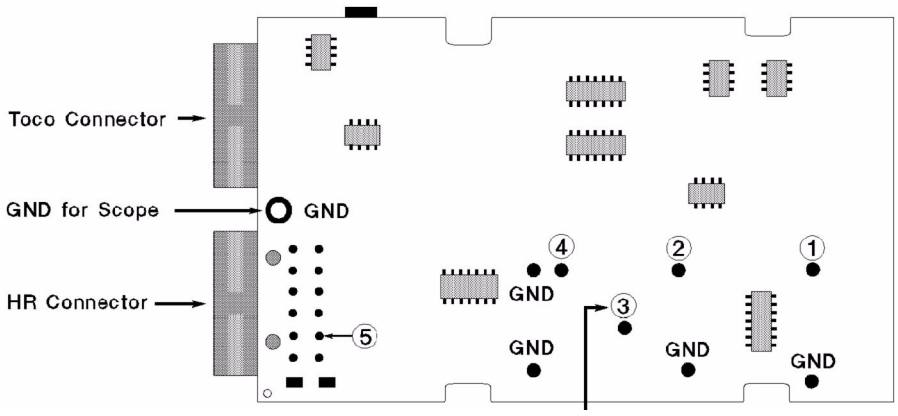


Figure 17 Transmitter VCXO Test

Test Point	Correct Signal	Action If Signal Incorrect
1	+2.5V DC	Replace Transmitter Board.[1]
2	+2.5V DC overlayed a sine 0.5 to 1Vpp FSK-signal 1.6kHz/2.4kHz. See Figure 18.	Replace Transmitter Board.[1]
3	+5V DC	Replace Transmitter Board.[1]

1. Do not forget to program the Serial Number to the Transmitter Board using the Service Software. Without the correct Serial Number the +5V and the FSK signal are not present, as they are switched off.

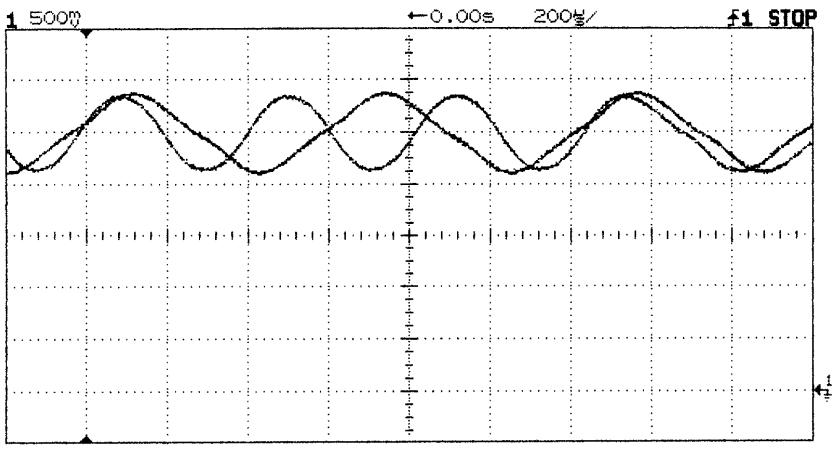


Figure 18 FSK Signal

8. Check the RF output signal with a Spectrum Analyzer 100Hz to ≥500 MHz, with an Active Probe 500 MHz (AC coupled, offset OFF).

The Spectrum Analyser should be set as follows:

START frequency	400 MHz
STOP frequency	500 MHz
Resolution Bandwidth	100 kHz
Video Bandwidth	100 kHz
Reference Level	+10 dBm

Test Point	Correct Signal	Action if signal incorrect
4	Peak Level >-6dBm	Replace Transmitter VCXO

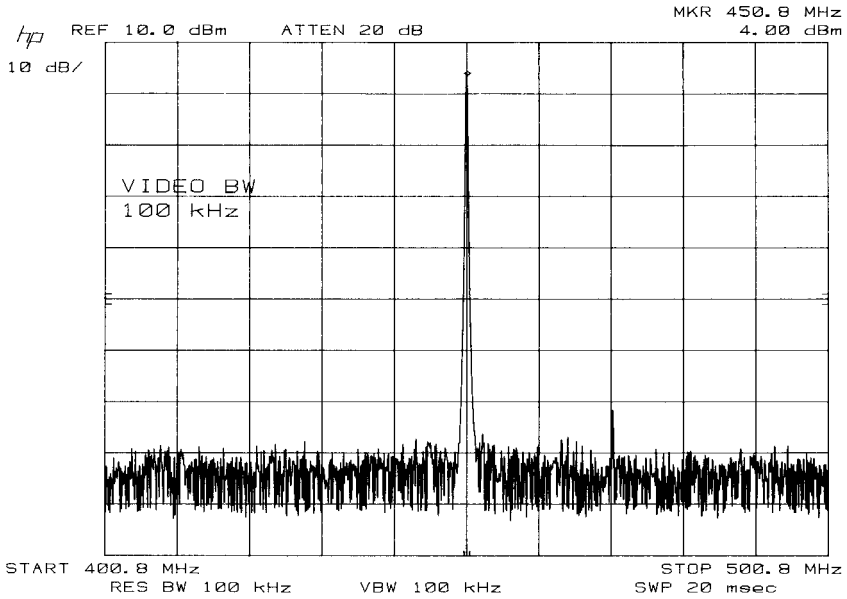


Figure 19 RF Output Signal

Test Point	Correct Signal	Action if signal incorrect
5	Peak Level >-12dBm	Replace Transmitter Processor board 501

9. Check the modulation. To check the modulation the Spectrum Analyzer should be set as follows:

CENTER frequency	The channel frequency of the Transmitter
Frequency Span	50 kHz
Resolution Bandwidth	300 Hz
Video Bandwidth	300 Hz
Reference Level	+10 dBm

Test Point	Correct Signal	Action if signal incorrect
4	Seee Figure 20	Replace Transmitter VCXO

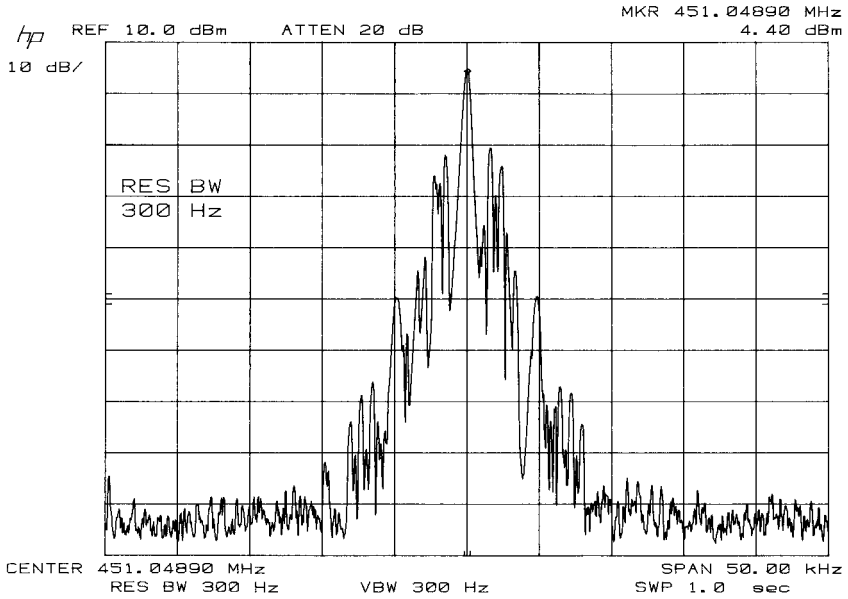


Figure 20 RF Modulation Signal

Receiver Preamplifier Test

1. Open the Receiver housing.
2. Remove the antenna from the rear BNC connector.
3. Unplug the BNC cable between the Preamplifier and the Receiver assembly at the Preamplifier BNC connector.
4. Switch on the Receiver. The green LED on the Preamplifier Board should be lit.
5. Connect the RF Generator output to the Receiver's antenna input with a BNC cable.

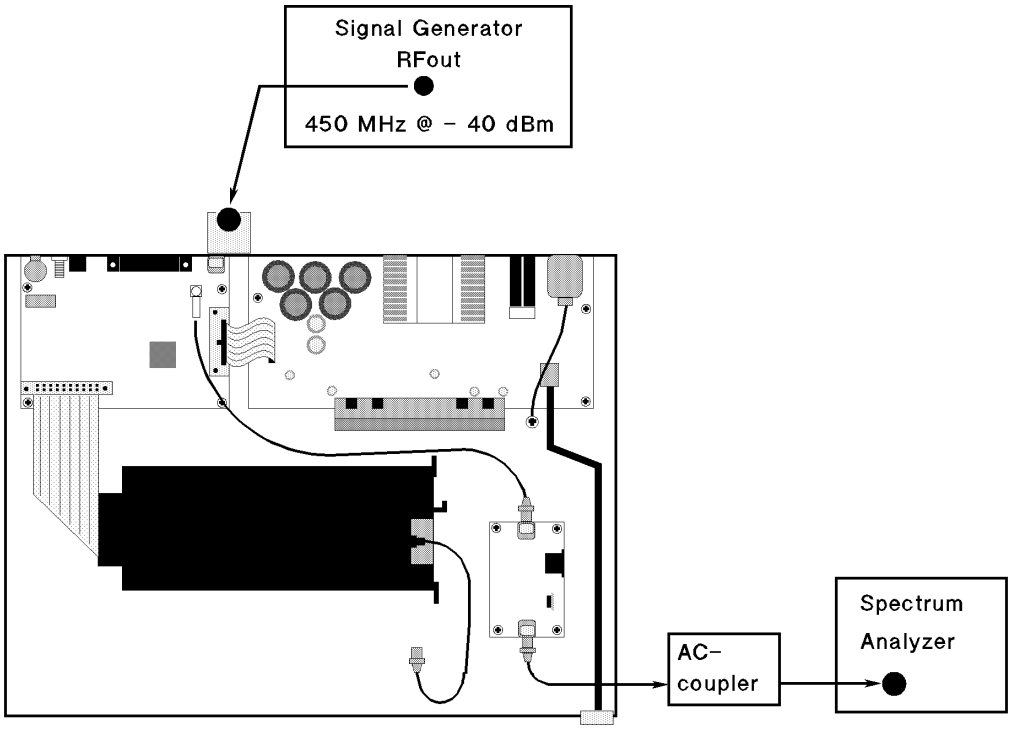


Figure 21 Receiver Preamplifier Test

6. Set the following on the Signal Generator:

Frequency	450 MHz
Level	-40 dBm

7. Using an AC Coupler, connect the Preamplifier's output to the input of the Spectrum Analyzer. The AC Coupler prevents the Spectrum Analyser input from receiving 21 V DC.

   The Spectrum Analyser should be set as follows:

START frequency	400 MHz
STOP frequency	500 MHz
Resolution Bandwidth	100 kHz
Video Bandwidth	100 kHz
Reference Level	-10 dBm

   The Spectrum Analyser measurement must be:

Frequency	450 MHz
Level	> - 32 dBm

   If this measurement is correct, complete Receiver Assembly Test.

8. Remove the BNC connector from the Preamplifier input and connect this cable to the Spectrum Analyzer.

   The Spectrum Analyser measurement must be:

Frequency	450 MHz
Level	> - 46 dBm

9. If this measurement is correct, replace the Preamplifier Board. If this measurement is not correct, replace the Coax cable. If this does not solve the problem, replace the Receiver Processor Board (503).

Receiver Assembly Test

1. Remove the flat cable and coax cable from the Receiver Assembly.
2. Pull out and turn over the Receiver Assembly and undo all 7 screws.
3. Lift up the top cover of the Receiver Assembly and connect the flat cable again.

4. Switch on the Receiver. The green LED on the Receiver Assembly should flicker. Check the +5V, -12V and +12V voltages at the marked capacitors.

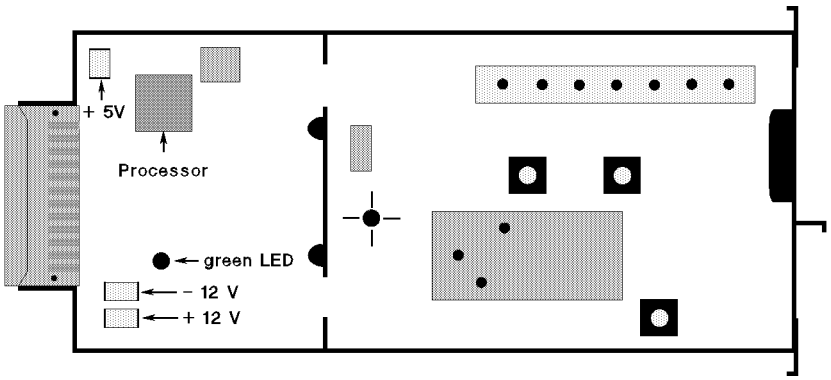


Figure 22 Receiver Assembly Test

5. If all voltages are present and the green LED is flickering now test Receiver VCXO.

6. If all voltages are correct and the green LED is not flickering, replace the Receiver Assembly. Check for processor part number higher than or equal to 1821-1141 on the Receiver Assembly. If any voltage is incorrect replace the flat cable. If the problem is still not solved, replace Receiver Processor Board (503).

Receiver VCXO Test

You require a Spectrum Analyzer and Active Probe to carry out this test.

1. Check the Receiver VCXO ouput signal at the transistor amplifier.

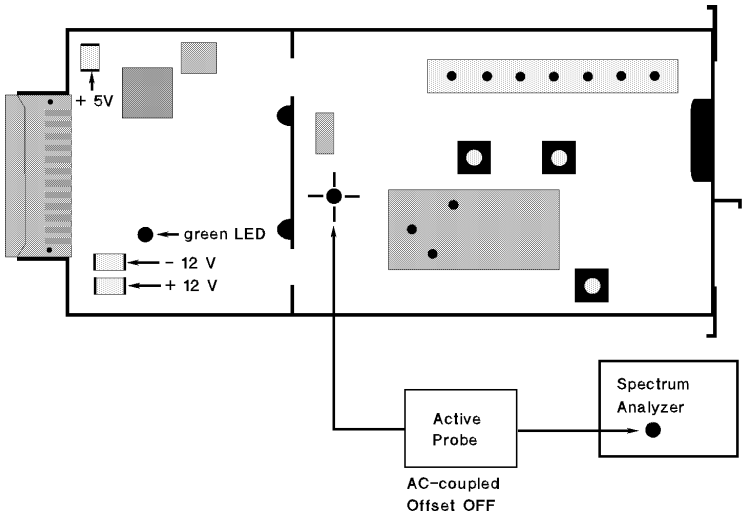


Figure 23 Receiver VCXO Test

The Spectrum Analyser should be set as follows:

START frequency	400 MHz
STOP frequency	500 MHz
Resolution Bandwidth	100 kHz
Video Bandwidth	100 kHz
Reverence Level	+10 dBm

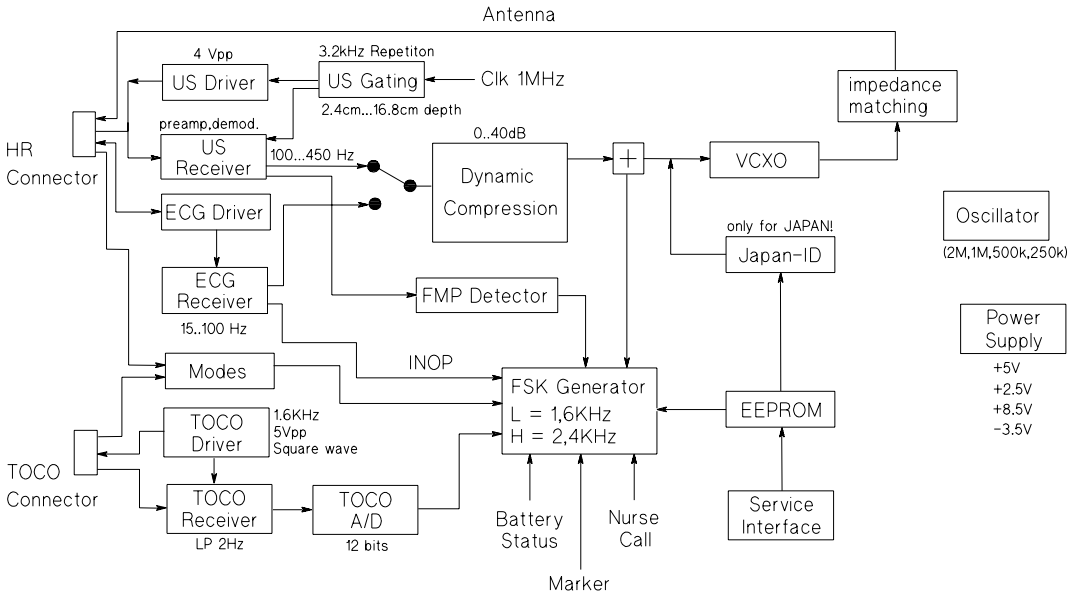
The Spectrum Analyser measurement must be:

Frequency	Channel Frequency + 21 .400 MHz +/- 5kHz
Level	> - 6 dBm

2. If the level is lower the Receiver VCXO is to be replaced. If the frequency and level are correct the Receiver Assembly needs to be replaced.

9
Theory of Operation

Transmitter Functional Blocks



US Gating

The US Gating circuitry generates the gated 1 MHz bursts for the US driver and the US receiver necessary in a pulsed doppler system.

The burst repetition rate is 3.2 kHz. The US driver burst has a duration of 96 μsec. The burst for the Receiver's demodulator, which also has a duration of 96 μsec, follows the driver bursts with a delay of 32 μsec. This timing gives a sensitive depth range from 2.4cm up to 16.8cm (with a sound velocity in human tissue of 1500 m/sec.)

US Driver

The US Driver circuitry drives the ultrasound transducer crystals with the bursts delivered by the US Gating module. The output amplitude is 4V peak to peak. The drivers output goes to a high impedance state when the driving burst is inactive.

US Receiver

The US Receiver consists of three submodules:

- Preamplifier
- Demodulator
- Bandpass filter with amplification

The preamplifier amplifies the small doppler shifted 1MHz signals from the transducer. These are converted to the low frequency baseband by the

demodulator. This demodulator is driven by the US Gating module with 1 MHz bursts. The demodulated signals are amplified and bandpass filtered.

The overall gain from the transducer to the US Receiver's output is 70 dB for the heartrate signal and 56 dB for the fetal movement signal.

ECG Driver

This circuitry powers an ECG transducer with a 5V peak to peak, 250 kHz square wave. The driver current is sensed by the ECG Receiver.

ECG Receiver

After converting into a voltage, the signal is amplified and bandpass filtered. The filter consists of a 15 Hz highpass and a 100 Hz lowpass. The overall gain from the transducer inputs to the ECG Receiver's output is 56 dB. In addition, the ECG Receiver outputs an INOP flag if the 50/60 Hz signal or an INOP signal (250Hz delivered by the ECG transducer if electrodes have no contact) of a too high amplitude is detected.

Dynamic Compression Circuitry

The Dynamic Compression Circuitry consists of:

- Programmable Gain Amplifier (PGA)
- Automatic Gain Control (AGC)

The PGA is a special amplifier with a programmable gain factor between 0 dB and 40 dB in 255 steps. It adapts the high dynamic range (>60 dB) of the heartrate signals to the limited dynamic range of the RF link. The PGA is controlled by the Automatic Gain Control.

The AGC circuitry sets the gain of the PGA to get the best usage of the RF link dynamic range. The actual heartrate singal amplitude is measured by a peak hold detector which is the input signal for the controller algorithm. The

algorithms for ECG and ultrasound signals are different. They are adapted to the special attributes of the signals. This results in different time constants, amplitude margins etc.

The gain is changed only between two signal complexes where the signal is approximately zero to avoid destruction of the signal complexes which may lead to an inaccurate calculated heartrate in the Fetal Monitor (artificial jitter).

FMP Detector

The FMP Detector consists of two parts:

- The FMP Envelope
- The FMP Detector

The FMP Envelope circuitry builds the envelope signal of the fetal movement profile doppler signal from the US receiver. It is a full wave rectifier followed by a 12 Hz lowpass.

The Fetal Movement Profile Detector searches for fetal movement related signals in the FMP envelope signal. If a movement is detected, a status bit is

delivered to the FSK Generator. The detector algorithm is identical to the algorithm implemented in the Series 50 Fetal Monitors.

FMP is switched off whenever a Series 50 T Telemetry System (plugged into the Monitor) is switched on. FMP is switched back on again when the telemetry system is switched off (or unplugged). If you want to monitor FMP with a Series 50 T Telemetry System (and have the correct software revision and interface for Telemetry FMP) switch FMP on by using either the Key or the barcode method.

Modes

This module checks for connected transducers at the Cardio and Toco connectors. If a valid transducer is detected, the corresponding operating modes are set in the Transmitter (ECG/US, TOCO/IUP) and the mode encoding bits are delivered to the FSK signal generator. If an invalid transducer is detected, these bits are set to an error code and the Transmitter frontends are disabled.

Toco Driver

This circuitry drives a connected Toco or IUP transducer with a 1.6 kHz, 5V peak square wave. The 1.6 kHz frequency is synchronised with the 3.2 kHz repetition rate of the doppler ultrasound circuitries to avoid interference between the Toco and ultrasound channels.

Toco Receiver

This module contains a differential intput amplifier, a synchronous demodulator and a low pass filter, to derive a pressure proportional signal from the TOCO/IUP transducers bridge.

Toco A/D

The TOCO/IUP pressure signal is A to D converted by a sigma-delta type converter with a resolution of 12 bits and a 2Hz low pass characteristic. The repetition rate is 4/sec. These 12 bits are encoded in the serial bitstream by the FSK Generator module.

To ensure a high accuracy of the Toco pressure signal, correction factors are stored in a EEPROM during the production test individually for every Transmitter. Before encoding the Toco pressure values into the serial bitstream, the pressure values are corrected with these factors. This mechanism allows the usage of circuitries in the Toco frontends which only have stability over temperature and aging but not an absolute accuracy.

FSK Generator

The Frequency Shift Key generator (FSK), is a sine wave generator (smoothed square wave by filters) capable of generating either a frequency of 1.6 kHz (represents a logic zero) or 2.4 kHz (represents a logic one). It encodes the following signals in a bitstream:

- Coding pattern identification
- Transmitters Serial Number
- 12 Bit Toco pressure value

- transducers and operating modes
- fetal movement detection bit
- battery status
- external marker information
- Nurse call button
- INOP condition of ECG
- CRC (checksum over one frame)
- Special transmitter ID after power up (Japan only)

Oscillator

This circuitry produces the different clocks needed in the Transmitter. The oscillator is crystal controlled and starts operation at power supply voltages as low as 2V. This is necessary because the oscillator also drives the power supply. To ensure a start up over the complete specified battery voltage range, the oscillator must start at this low voltage. The clock freqencies are:

- 2 MHz for the mircocontroller
- 1 MHz for the ultrasound drive/receive clocks and the power supply.
- 500 kHz for the Toco sigma-delta A/D converter.
- 250 kHz for the ECG driver and the Toco sigma-delta A/D converter.

Power Supply

The power supply is a switched mode power supply with step up operation. It works with a 250 kHz clock frequency (delivered by the oscillator) in a pulse width modulation mode. It is capable of delivering the necessary power in a fixed 5V output voltage for input voltages between 2.5V and 4.7V. (This covers the input voltages delivered by three AA type alkaline batteries or three AA type NiCd/NiHd accumulators).

Other supply voltages are derived from the 5V supply by linear regulators or by charge pumps runing at 250 kHz.

- 2.5V as virtual ground (linear regulator)
- 8.5V for ultrasound preamplifier and OP-Amps (charge pump as voltage doubler.)
- -3.5V for OP-Amps (charge pumps as voltage inverter).

Service Interface

The service and production interface uses the marker input as the I/O connector for settings and internal status readings for service and production tests.

It is a RS232 similiar (0.5V only levels) serial interface with a specific protocol. This interface is used for:

- setting the Transmitter's serial number
- reading some internal values for prodution tests
- writing correction factors for the Toco frontend into the EEPROM.

EEPROM

The EEPROM holds the following settings:

- Serial number
- Gain calibration factors
- Country code
- Japanese ID code

Japan ID

This module is only acitve for Japanese options (set by the country code). It sends the required ID code for Japanese Telemetry Transmitters. If there is no valid ID code (or country code) in the EEPROM, this module shuts off the VCXO. RF emission is allowed only if a correct ID code is emitted first after power up.

VCXO

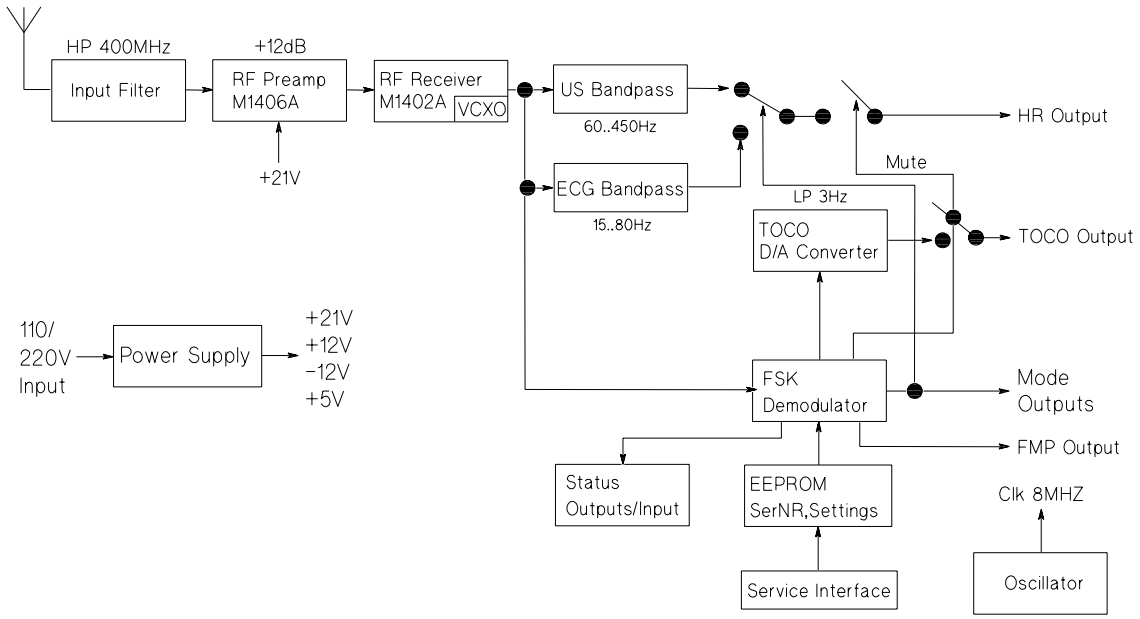
The Voltage Controlled Xtal (crystal) Oscillator is a "MAGIC" M1400-6XXXX type VCXO. It generates the 4mW, 2mW or 1mW RF carrier in the 406 to 470 MHz band. This is dependant on county options:

- 4 mW for USA and Australia
- 2 mW for Europe
- 1 mw for Japan

It also performs the FM modulation for this carrier with the composite signal of the ultasound doppler or the fetal scalp ECG and the FSK subcarrier for the digital information. The heart rate signals use 60% and the FSK subcarrier uses 40%of the available RF peak deviation. An additional lowpass filter at the VCXO's output reducers the RF carrier harmonics.

The outer shield of the heart rate transducer cables is used as an antenna. An impedence matching network adapts the antenna impedance to the VCXO's 50 Ohms output.

Receiver Functional Blocks



Input Filter

This module builds up a highpass filter with <1dB loss in the useful frequency range 406 to 470 MHz and >20dB rejection for 100 MHz signals. It prevents overloading of the RF preamplifier with strong lower frequency signals.

The filter also provides the preamplifier with a 21V DC power by coupling this DC voltage into the hot wire of the preamplifiers input cable. A capacitor decouples the DC power from the antenna input.

RF Preamp M1406A

This MAGIC line amplifier boosts the input signal by 12 dB. This results in an input sensitivity of about -118 dBm together with the M1402A RF Receiver. The amplifier is powered from the DC power at the hot wire of the input coax cable.

RF Receiver M1402A

The MAGIC receiver module M1402A performs the complete baseband signal recovery. The input signal is prefiltered, mixed down and filtered by a double superhetrodyne circuitry and demodulated to the baseband signal. An on board microcontroller does the complete automatic frequency control tracking of the input signal.

US Bandpass

This module performs a bandfiltering for the ultrasound doppler signal. It consists of a 60 Hz highpass to remove the low frequency noise of the FM demodulator, a 450 Hz lowpass to remove the higher frequency noise, and the FSK subcarrier. The subcarrier attenuation must be so high that it is not audible in the ultrasound signal (>70 dB at 1.6 kHz).

ECG Bandpass

This module performs a bandfiltering for the fetal scalp ECG signal with a 15 Hz highpass, to remove the low frequency noise (low frequency phase noise of the RF oscillators) and a 80 Hz lowpass, to remove the high frequency noise and the FSK subcarrier.

The output of the US or ECG bandpass is selected by the decoded mode information by the FSK Demodulator and fed to the receiver output as heartrate output. If the input signal quality is too bad (bit error rate increase over a certain limit), the heartrate and Toco output is switched off.

FSK Bandpass

This bandpass selects the FSK subcarrier out of the composite signal. It consists of a 1.6 KHz highpass to remove the low frequency noise and the heart rate signals, and a 2.4 kHz lowpass to eleminate the high frequency noise.

FSK Demodulator

The FSK Demodulator consists of:

- FSK Comperator
- FSK Demodulator

The Comperator converts the sine shaped FSK subcarrier signal into a square wave. The Comperator has a hysteresis to improve the performance of noisy input signals. The Demodulator demodulates the FSK subcarrier and recovers the encoded bitstream. The synchronisation is done by searching the encoded 12 bit serial number. The bitstream is also descrambled and the CRC is checked. If the test is positive, the complete frame is saved and the information bits are recovered and appropriate actions are taken:

- Set the Mode outputs
- Display the status values on the front panel.
- Switch On/Off the nurse call beeper
- Switch On all output signals
- Set the fetal movement output

- Encode the marker signal into the Toco signal

If more than two consecutive frames are disturbed (wrong CRC checksum) or no synchonisation is possible due to not matching serial numbers of the transmitter and the receiver, the output signals are switched off and the range/ transmission INOP LED on the frontpanel is switched on.

Toco D/A Converter

This module converts the digital Toco value (12 bits) into an analog voltage (the fetal monitors can only accept analog input signals for all parameters). It is built up with a pulse width modulator followed by a 3Hz lowpass.

The marker is also encoded with the Toco output signal. If a marker pressed bit is received, the Toco signal will make a deflection over the complete range for 1 second if a fetal monitor with an old telemetry interface is connected. If a new interface is detected, the marker will be output as a digital mode output only.

EEPROM

The EEPROM keeps the following settings:

- Serial Number
- Nurse Call volume control

These values all can be set via the Service/Production interface, or in the case of the nurse call volume control, by pressing the nurse call acknowledge button if no nurse call is active.

Service Interface

This is a RS232 type serial interface used for servicing and production test and settings, to read back internal values or to store serial numbers and other settings in the EEPROM.

Power Supply

This module delivers all the necessary supply voltages. It has an input selector for 110V or 230V mains input. It outputs the following voltages:

+21V	RF Preamplifier
+12V	Analog circuitries and the M1402A Receiver Module
-12V	Analog circuitries and the M1402A Receiver Module
+5V	Digital circuitries and the M1402A Receiver Module

Oscillator

The oscillator produces a CMOS clock signal for the digital circuitries. It is running at 16.256 MHz. This frequency is divided by 2; the resulting 8.128 MHz frequency is used as a clock signal for the microcontroller.

10
Preventive Maintenance, Care and Cleaning

Preventive Maintenance

Every 12 months, you must carry out a series of preventive maintenance tasks and performance assurance tests. These ensure that the Telemetry System continues to perform at its best, and reduces the possibility of failures. The tasks to be carried out, their sequence, and the estimated time to complete each one is given in the following table.

No.	Tasks and Tests
1.	Mechanical Inspections
2.	Carry out Safety Tests
3.	Performance Assurance Tests

Mechanical Inspection

To carry out a mechanical inspection of the Receiver:

- Make sure all exposed screws are tight.
- Make sure the boards and connectors are firmly in place.
- Check the external cables for splits, cracks or signs of twisting. Replace any cables that show serious damage.

Safety Tests

Complete the safety tests in accordance with national requirements.

Performance Assurance Tests

See the *Instructions for Use* for details.

Care and Cleaning of the Telemetry System

For care and cleaning instructions, please refer to the *Instructions for Use*.

11
Channels and Frequencies

VCXO Operation Frequency

The Receiver VCXO operation frequency equals the channel frequency plus 21.4 MHz.

Austria

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
J01	801	449.775	M1400-61801	M1402-61801
J02	802	449.800	M1400-61802	M1402-61802
J03	803	449.850	M1400-61803	M1402-61803
J04	804	449.825	M1400-61804	M1402-61804

Australia

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
A10	510	469.500	M1400-61510	M1402-61510
A11	511	469.525	M1400-61511	M1402-61511
A12	512	469.550	M1400-61512	M1402-61512
A13	513	469.575	M1400-61513	M1402-61513
A14	514	469.600	M1400-61514	M1402-61514
A15	515	469.625	M1400-61515	M1402-61515
A16	516	469.650	M1400-61516	M1402-61516
A17	517	469.675	M1400-61517	M1402-61517
A18	518	469.700	M1400-61518	M1402-61518
A19	519	469.725	M1400-61519	M1402-61519

Belgium

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
001	001	467.775	M1400-61001	M1402-61001
002	555	470.025	M1400-61555	M1402-61555
003	556	470.050	M1400-61556	M1402-61556
005	557	470.075	M1400-61557	M1402-61557
006	558	470.100	M1400-61558	M1402-61558
391	391	457.525	M1400-61391	M1402-61391
392	392	457.600	M1400-61392	M1402-61392
393	393	466.2375	M1400-61393	M1402-61393
D05	605	448.250	M1400-61605	M1402-61605
D06	606	448.275	M1400-61606	M1402-61606
D08	608	448.125	M1400-61608	M1402-61608
D09	609	448.150	M1400-61609	M1402-61609
D10	610	448.175	M1400-61610	M1402-61610
D11	611	448.200	M1400-61611	M1402-61611
D12	612	448.225	M1400-61612	M1402-61612

Canada

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
J01	801	449.775	M1400-61801	M1402-61801
J02	802	449.800	M1400-61802	M1402-61802
J03	803	449.850	M1400-61803	M1402-61803
L01	701	458.500	M1400-61701	M1402-61701
L02	702	458.525	M1400-61702	M1402-61702
L03	703	458.5625	M1400-61703	M1402-61703

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
L04	704	458.5875	M1400-61704	M1402-61704
L05	705	458.700	M1400-61705	M1402-61705
L06	706	458.725	M1400-61706	M1402-61706
L07	707	458.775	M1400-61707	M1402-61707
L08	708	458.800	M1400-61708	M1402-61708

Denmark

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
D01	601	448.000	M1400-61601	M1402-61601
D02	602	448.025	M1400-61602	M1402-61602
D03	603	448.075	M1400-61703	M1402-61603
D04	604	448.100	M1400-61604	M1402-61604
D05	605	448.250	M1400-61605	M1402-61605
D06	606	448.275	M1400-61606	M1402-61606
D07	607	448.050	M1400-61607	M1402-61607
D08	608	448.125	M1400-61608	M1402-61608
D09	609	448.150	M1400-61609	M1402-61609
D10	610	448.175	M1400-61610	M1402-61610
D11	611	448.200	M1400-61611	M1402-61611
D12	612	448.225	M1400-61612	M1402-61612

Eastern European Countries

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
001	001	467.775	M1400-61001	M1402-61001

Finland

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
H01	741	468.525	M1400-61741	M1402-61741
H02	742	468.575	M1400-61742	M1402-61742

France

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
G04	544	433.250	M1400-61544	M1402-61544
G06	548	433.350	M1400-61548	M1402-61548
G07	791	433.600	M1400-61791	M1402-61791
G08	598	433.625	M1400-61598	M1402-61598
G09	599	433.650	M1400-61599	M1402-61599
G10	588	433.675	M1400-61588	M1402-61588
G11	600	433.700	M1400-61600	M1402-61600
G12	671	433.750	M1400-61671	M1402-61671
G13	677	433.900	M1400-61677	M1402-61677
G14	678	433.925	M1400-61678	M1402-61678
G15	679	433.950	M1400-61679	M1402-61679

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
G16	681	434.000	M1400-61681	M1402-61681
G17	682	434.025	M1400-61682	M1402-61682
G18	683	434.050	M1400-61683	M1402-61683
G19	684	434.075	M1400-61684	M1402-61684
G20	685	434.100	M1400-61685	M1402-61685
G21	686	434.125	M1400-61686	M1402-61686
G22	687	434.150	M1400-61687	M1402-61687
G23	688	434.175	M1400-61688	M1402-61688

Germany

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
G04	544	433.250	M1400-61544	M1402-61544
G06	548	433.350	M1400-61548	M1402-61548
G07	791	433.600	M1400-61791	M1402-61791
G08	598	433.625	M1400-61598	M1402-61598
G09	599	433.650	M1400-61599	M1402-61599
G10	588	433.675	M1400-61588	M1402-61588
G11	600	433.700	M1400-61600	M1402-61600
G12	671	433.750	M1400-61671	M1402-61671
G13	677	433.900	M1400-61677	M1402-61677
G14	678	433.925	M1400-61678	M1402-61678
G15	679	433.950	M1400-61679	M1402-61679
G16	681	434.000	M1400-61681	M1402-61681

Italy

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
all	xxx	430-470	M1400-61xxx	M1402-61xxx

Japan

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
J19	J119	440.600	M1400-63119	M1402-63119
J20	J120	440.625	M1400-63120	M1402-63120
J21	J121	440.650	M1400-63121	M1402-63121
J22	J122	440.675	M1400-63122	M1402-63122
J23	J123	440.700	M1400-63123	M1402-63123
J24	J124	440.725	M1400-63124	M1402-63124
J25	J125	440.750	M1400-63125	M1402-63125
J26	J126	440.775	M1400-63126	M1402-63126
J27	J127	440.800	M1400-63127	M1402-63127
J28	J128	440.825	M1400-63128	M1402-63128
J29	J129	440.850	M1400-63129	M1402-63129
J30	J130	440.875	M1400-63130	M1402-63130

Luxembourg

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
001	001	467.775	M1400-61001	M1402-61001
002	555	470.025	M1400-61555	M1402-61555
003	556	470.050	M1400-61556	M1402-61556
005	558	470.075	M1400-61557	M1402-61557
006	001	470.100	M1400-61558	M1402-61558
391	391	457.525	M1400-61391	M1402-61391
392	392	457.600	M1400-61392	M1402-61392
393	393	466.2375	M1400-61393	M1402-61393
D05	605	448.250	M1400-61605	M1402-61605
D06	606	448.275	M1400-61606	M1402-61606
D08	608	448.125	M1400-61608	M1402-61608
D09	609	448.150	M1400-61609	M1402-61609
D10	610	448.175	M1400-61610	M1402-61610
D11	611	448.200	M1400-61611	M1402-61611
D12	612	448.225	M1400-61612	M1402-61612

Netherlands

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
G09	599	433.650	M1400-61599	M1402-61599
G13	677	433.900	M1400-61677	M1402-61677
G14	678	433.925	M1400-61678	M1402-61678
G15	679	433.950	M1400-61679	M1402-61679
G16	681	434.000	M1400-61681	M1402-61681
G17	682	434.025	M1400-61682	M1402-61682

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
G18	683	434.050	M1400-61683	M1402-61683
G19	684	434.075	M1400-61684	M1402-61684
G20	685	434.100	M1400-61685	M1402-61685
G21	686	434.125	M1400-61686	M1402-61686
G22	687	434.150	M1400-61687	M1402-61687
G23	688	434.175	M1400-61688	M1402-61688

New Zealand

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
A01	551	466.8125	M1400-61551	M1402-61551
A02	552	466.8375	M1400-61552	M1402-61552
A03	553	466.8625	M1400-61553	M1402-61553
A04	554	466.8875	M1400-61554	M1402-61554

Norway

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
N01	721	441.975	M1400-61721	M1402-61721
N02	722	441.925	M1400-61722	M1402-61722
N03	723	441.985	M1400-61723	M1402-61723
N04	724	441.900	M1400-61724	M1402-61724
N05	725	441.875	M1400-61725	M1402-61725
N06	726	441.950	M1400-61726	M1402-61726

Service USA

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
391	391	457.525	M1400-61391	M1402-61391
392	392	457.600	M1400-61392	M1402-61392
393	393	466.2375	M1400-61393	M1402-61393

Singapore

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
S14	314	454.125	M1400-61314	M1402-61313
S18	318	454.225	M1400-61318	M1402-61318
S22	322	454.325	M1400-61322	M1402-61322
S28	328	454.475	M1400-61328	M1402-61328

Spain

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
all	xxx	4430-470	M1400-61xxx	M1402-61xxx

Sweden

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
K01	751	439.750	M1400-61751	M1402-61751
K02	752	439.775	M1400-61752	M1402-61752
K03	753	439.800	M1400-61753	M1402-61753
K04	754	439.825	M1400-61754	M1402-61754
K05	755	439.850	M1400-61755	M1402-61755
K06	756	439.875	M1400-61756	M1402-61756
K07	757	439.950	M1400-61757	M1402-61757
K08	758	439.975	M1400-61758	M1402-61758
K09	759	439.900	M1400-61759	M1402-61759
K10	760	439.925	M1400-61760	M1402-61760

Switzerland

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
G04	544	433.250	M1400-61544	M1402-61544
G06	548	433.350	M1400-61548	M1402-61548
G07	791	433.600	M1400-61791	M1402-61791
G11	600	433.700	M1400-61600	M1402-61600
G12	671	433.750	M1400-61671	M1402-61671
G18	683	434.050	M1400-61683	M1402-61683
G22	687	434.150	M1400-61687	M1402-61687

UK

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
L01	701	458.500	M1400-61701	M1402-61701
L01	702	458.525	M1400-61702	M1402-61702
L01	703	458.5625	M1400-61703	M1402-61703
L01	704	458.5875	M1400-61704	M1402-61704
L01	705	458.700	M1400-61705	M1402-61705
L01	706	458.725	M1400-61706	M1402-61706
L01	707	458.775	M1400-61707	M1402-61707
L01	708	458.800	M1400-61708	M1402-61708

USA

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
U20	020	460.6875	M1400-62020	M1402-61020
U21	021	460.7375	M1400-62021	M1402-61021
U22	022	460.8375	M1400-62022	M1402-61022
U23	023	460.6625	M1400-62023	M1402-61023
U24	024	460.8625	M1400-62024	M1402-61024
U25	025	460.7875	M1400-62025	M1402-61025
U26	026	460.7125	M1400-62026	M1402-61026
U27	027	460.7625	M1400-62027	M1402-61027
U28	028	460.8125	M1400-62028	M1402-61028
U30	030	468.3625	M1400-62030	M1402-61030
U31	031	468.4375	M1400-62031	M1402-61031
U32	032	468.3875	M1400-62032	M1402-61032
U33	033	466.2125	M1400-62033	M1402-61033

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
U34	034	466.2625	M1400-62034	M1402-61034
U35	035	466.3375	M1400-62035	M1402-61035
U36	036	466.2875	M1400-62036	M1402-61036
U37	037	468.7625	M1400-62037	M1402-61037
U38	038	468.8125	M1400-62038	M1402-61038
U39	039	468.8875	M1400-62039	M1402-61039
U40	040	468.8375	M1400-62040	M1402-61040
U41	041	469.0875	M1400-62041	M1402-61041
U42	042	469.1375	M1400-62042	M1402-61042
U43	043	469.2125	M1400-62043	M1402-61043
U44	044	469.1625	M1400-62044	M1402-61044
U45	045	466.6625	M1400-62045	M1402-61045
U46	046	466.7125	M1400-62046	M1402-61046
U47	047	466.7875	M1400-62047	M1402-61047
U48	048	466.7375	M1400-62048	M1402-61048
U49	049	468.2875	M1400-62049	M1402-61049
U50	050	468.3375	M1400-62050	M1402-61050
U87	087	466.4125	M1400-62087	M1402-61087
U88	088	466.4875	M1400-62088	M1402-61088
U89	089	466.5625	M1400-62089	M1402-61089
U90	090	466.8375	M1400-62090	M1402-61090
U91	091	466.9125	M1400-62091	M1402-61091
U92	092	466.5875	M1400-62092	M1402-61092
U93	093	466.9875	M1400-62093	M1402-61093
U94	094	466.8625	M1400-62094	M1402-61094
U95	095	466.6125	M1400-62095	M1402-61095
U96	096	466.9375	M1400-62096	M1402-61096
391	391	457.525	M1400-61391	M1402-61391
392	392	457.600	M1400-61392	M1402-61392

M1310A Option	Ref M1402A	Channel Frequency (MHz)	Transmitter VCXO-P/N	Receiver VCXO-PN
393	393	466.2375	M1400-61393	M1402-61393

USA

Index

B

batteries
low warning light, 18
operating time, 17
bench repair
RF, 59, 69, 77, 79
bench test
Receiver assembly, 65
Receiver preamplifier, 64
Receiver VCXO, 66
Transmitter VCXO, 60

C

cables, 8
remote event marker, 10
service cable assembly, 33
transducer, 8
Channel Frequency, 79
Frequency option numbers, 79

D

DECG transducers, 9
display board
replacement and removal, 57
Dynamic Compression Circuitry, 70

E

ECG Bandpass, 75
ECG Driver, 70
ECG Receiver, 70
EEPROM
Receiver functional blocks, 74
transmitter, 73
environment, 2
specifications, 5
error flowchart
cardio channel, 25
event marker, 29
FMP, 27
no LED's lit on receiver, 19
not all LED's lit, 21
nurse call, 30
Toco channel, 26
transducer not detected, 24
transmission INOP range, 22
transmission range, 23
yellow LED stays on, 21
error messages, 14

F

fetal monitor interface
pin connections, 31
FMP Detector, 70
FSK Bandpass, 75
FSK Demodulator, 75
FSK Generator, 71
fuse
part numbers, 44
replacement and removal, 58
values, 58

I

Input Filter, 74
interface
pin connections, 31
to fetal monitor, 31
IUP transducer
specifications, 10

J

Japan ID, 73

M

maximum input/output voltages, 4
Modes, 71

O

operating
environment, 2
temperatures, 2
Oscillator
Receiver, 76
Transmitter, 72

P

parameter test, 13
parts
ordering, 39
replacing, 39
parts list
Receiver Boards, 42
Receiver Parts, 42
transducers, 45
Transmitter, 40
patient safety, 2
pin connections
fetal monitor interface, 31
power supply
Receiver, 76
replacement and removal, 53
Transmitter, 72
preventive maintenance, 77
problem solving, 17
problems
solving general, 17
processor board
replacement and removal, 54
protective earth, 3

R

Receiver
assembly bench test, 65
VCXO bench test, 66
VCXO replacement and removal, 56
receiver
preamplifier bench test, 64
testing, 11

Receiver functional blocks
ECG Bandpass, 74
EEPROM, 74
FSK Bandpass, 74
FSK Demodulator, 74
Input Filter, 74
Oscillator, 74
power supply, 74
RF Preamp M1406A, 74
RF Receiver M1402A, 74
service interface, 74
Toco D/A Converter, 74
US Bandpass, 74
Receiver VCXO Test, 67
remote event marker
cables, 10
specifications, 10
replacement and removal, 39
display board, 57
fuses, 58
power supply board, 53
processor board, 54
Receiver VCXO, 56
RF amplifier, 57
RF Module, 55
Transmitter, 46
Transmitter processor board, 47
Transmitter VCXO, 48, 50
RF
amplifier replacement and removal, 57
bench repair, 59, 69, 77, 79
bench test, 59
Module replacement and removal, 55
Preamp M1406A, 74
Receiver M1402A, 75

S

safety, 1
self test, 7
receiver, 11
transmitter, 12
service interface, 76
service program, 33
cable assembly, 33
check receiver, 36
check transmitter, 36
exit, 37
power on self test, 36
read country information, 37
read serial number/ revisions, 36
reset serial number, 37
serial number to receiver, 36
serial number to transmitter, 36
show last error/warning, 36
using, 34
specifications
antenna, 6
channels & frequencies, 6
DECG transducers, 9
environment, 5
inputs, 6
IUP transducer, 10
power requirements, 5
remote event marker, 10
Telemetry, 5
Toco transducer, 8
storage
temperatures, 2

T

testing, 7
parameter test, 13
Receiver assembly, 65
Receiver preamplifier, 64
receiver self test, 11
Receiver VCXO, 66
RF bench test, 59
self test, 7
transmitter self test, 12
Transmitter VCXO, 60
theory of operation, 69
Dynamic Compression Circuitry, 70
ECG Bandpass, 75
ECG Driver, 70
ECG Receiver, 70
EEPROM transmitter, 73
EEPROM, Receiver, 76
FMP Detector, 70
FSK Bandpass, 75
FSK Demodulator, 75
FSK Generator, 71
Input filter, 74
Japan ID, 73
Modes, 71
Oscillator Receiver functional blocks, 76
Oscillator transmitter, 72
power supply transmitter, 72
power supply, Receiver, 76
RF Preamp M1406A, 74
RF Receiver M1402A, 75
service interface, 76
service interface transmitter, 72
Toco A/D, 71
Toco D/A Converter, 76
Toco Driver, 71
Toco Receiver, 71
Transmitter, 69
US Bandpass, 75
US Driver, 69
US Gating, 69
US Receiver, 69
VCXO, Transmitter, 73
Toco
A/D, 71
D/A Converter, 76
Driver, 71
Receiver, 71
transducer, 8
transducers, 8
cables, 8
DECG, 9
IUP, 10
Toco, 8

ultrasound, 8
watertight blue, 2
Transmitter
replacement and removal, 50
transmitter
testing, 12
Transmitter functional blocks
Dynamic Compression Circuitry, 69
ECG Driver, 69
ECG Receiver, 69
EEPROM, 69
FMP Detector, 69
FSK Generator, 69
Japan ID, 69
Modes, 69
Oscillator, 69
power supply, 69
service interface, 69
Toco A/D, 69
Toco Driver, 69
Toco Receiver, 69
US Driver, 69
US Gating, 69
US Receiver, 69
VCXO, 69
Transmitter processor board
replacement and removal, 47
Transmitter VCXO
bench test, 60
replacement and removal, 50
troubleshooting, 17
general problems, 17
troubleshooting flowchart
cardio channel, 25
event marker, 29
FMP, 27
no LED's lit on receiver, 19
not all LED's lit, 21
nurse call, 30
Toco channel, 26
transducer not detected, 24
transmission INOP range, 22
transmission range, 23
yellow LED stays on, 21

U

ultrasound transducer, 8
US Bandpass, 75
US Gating, 69
US Receiver, 69

V

VCXO
Receiver bench test, 67
Transmitter, 73
Transmitter bench test, 60
voltage
fuse values, 58
output power, 7
power requirements, 5
power supply board, 53